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BIOLOGY

1.

REPLACEMENT OF THE JUXTAMEMBRANE REGION OF SERRATE WITH A CORRESPONDING REGION OF DDR2 AND ITS EFFECT ON NOTCH ACTIVATION AND INHIBITION

Scott J. Buchanan ‘17
Faculty Sponsor: Robert Fleming

In *Drosophila melanogaster*, the Notch ligand known as Serrate extends through the cell membrane and contacts the Notch receptor on an adjacent cell to mediate changes in gene expression. Serrate contains a 23 amino acid transmembrane region (TM), which traverses the cell membrane. Adjacent to the TM section of Serrate on the extracellular side, there is a 272 amino acid juxtamembrane region (JM). It has been previously established that the complete deletion of this JM region eliminates the capability of the Serrate-expressing cell to activate Notch. Nonetheless, Serrate cells with the JM deletion retain the ability to inhibit Notch activity. When the TM domain of Serrate was replaced with the TM from the human DDR2 gene, the pathway worked as wild type indicating that the TM region was not unique for Serrate function. However, when both the JM and TM regions of Serrate were replaced with corresponding DDR2 segments, the system showed a failure to either activate or inhibit Notch receptor function. It has been theorized that the cause of this lack of function is that the DDR2 JM segment retained a discoidin-like region of approximately 40 amino acids that has been hypothesized to interact with collagen in the extracellular matrix. This interaction may prohibit the chimeric Serrate molecule from interacting with Notch. To that end, a new construct is being made that has had this discoidin-like region removed but retains the TM and remainder of the DDR2 JM segments. This converts the DDR2 JM domain to only 39 amino acids in length. It is theorized that this construct should allow both activation and inhibition of the Notch pathway.

2.

***IN VITRO* MODELING AND ANALYSIS OF CANCEROUS CHROMOSOME 8P ARM-LEVEL DELETION USING CRISPR-CAS9 SYSTEMS**

Michael S. Cuoco ‘16
Faculty Sponsors: Robert Fleming, Alison Taylor, Matthew Meyerson, Dana-Farber Cancer Institute

In tumor development, types of acquired genetic changes include single nucleotide polymorphisms (mutations), translocations, and copy number alterations. Somatic copy number alterations (SCNAs) are thought to drive tumorigenesis by the amplification or deletion of different sized regions across the genome. One type of somatic copy number alteration, arm-level SCNAs, include the amplification and deletion of entire chromosomes or chromosome arms. Chromosome arm 8p deletion has been reported as enriched in epithelial cancer types including breast, hepatocellular, lung, prostate, renal, and esophageal adenocarcinomas. Arm-level SCNAs have never been modeled in isolation and an effective model of an arm-level SCNA would provide a new path to discovery in cancer research. Here I describe my ongoing thesis project, which involves a unique approach to remove chromosome arm 8p *in vitro* with a novel genome editing tool. If successful, this method will generate a stable and testable model of 8p arm loss in cancer. To accomplish 8p removal, we have developed two plasmids to operate in

conjunction to cut chromosome arm 8p and replace it with an artificial telomere. We performed transfection into the HEK (human embryonic kidney) 293T cell line and amazingly, stable bulk populations were retrieved. In result, e*very* population tested positive for the presence of the artificial telomere on chromosome arm 8p from polymerase chain reaction (PCR) tests. At least four of the clonal populations have demonstrated consistent and significant low chromosome arm 8p levels relative to 8q in quantitative PCR (qPCR) tests. Three of the four clonal populations showed robust growth patterns in CellTiter-Glo® cell proliferation curves. Decisively, the collective data from the three clonal populations strongly supports their loss of chromosome arm 8p. Furthermore, more qPCR tests are being done to uncover additional possible 8p-loss clones. Our upcoming research includes entering these candidate clones into whole genome and whole transcriptome sequencing. My thesis research at Trinity is centered on in depth *in silico* algorithmic processing and analysis of these genome and transcriptome sequencing data. The methods of my research will provide conclusive data on 8p arm loss and the possible adverse genetic, genomic and expression-level effects of the arm loss.

3.

THE EFFECTIVENESS OF CAPSAICIN AS AN EASTERN GRAY SQUIRREL (*SCIURUS CAROLINENSIS*) DETERRENT AT BIRD FEEDERS IN URBAN ENVIRONMENTS

Lisley DaSilva ‘16, Meghan Barry ‘19
Faculty Sponsor: Michael O’Donnell

Eastern gray squirrels (*Sciurus carolinensis*) are one of the best urban adapters and have been shown to exist at higher population densities, have a reduced fear of humans, and an increased exposure to anthropogenic food sources, resulting in an array of new adaptations and increased nuisance activities in urbanized habitats. A main goal of urban wildlife management is to increase positive and decrease negative interactions with humans. Typical complaints about squirrels include: overconsumption of bird food, damage to bird feeders, entering homes, and causing power outages. Capsaicin has been suggested as a way to minimize negative interactions by effectively deterring mammals. Previous studies have shown capsaicin repels squirrels but not birds. However, no studies have been done in urban environments. Thus, the goal of this study is to determine if capsaicin is an effective eastern gray squirrel deterrent at bird feeders in urban environments. The study was conducted using a counterbalanced block design for 48 consecutive days at Trinity College, in Hartford, CT. We used three levels of capsaicin treatment on whole sunflower seeds (with shells) and sunflower meats (without shells). We found that no capsaicin treatment on whole seeds deterred feeding by squirrels, but higher capsaicin treatments did reduce squirrel feeding on sunflower meats. Only the highest capsaicin treatment lowered squirrel visitation rates at feeders. Additionally, capsaicin treatment at all levels did not affect consumption by birds. This study suggests that synurbic squirrels are more varied and tolerant to capsaicin treatments. Bird feeding enthusiasts who wish to deter squirrel feeding should use meats treated with high levels of capsaicin.

4.

LOOKING FOR OSCILLATING EXPRESSION OF NOTCH/DELTA DURING SEGMENTATION IN THE CRUSTACEAN, *THAMNOCEPHALUS PLATYURUS*

Nicole Duan ‘18
Faculty Sponsor: Terri A. Williams

This project investigates whether the expression of Notch/Delta genes in *Thamnocephalus platyurus* embryos is oscillating.

Segmentation is a prominent characteristic of all arthropods. In the intensively studied *Drosophila melanogaster*, the segments are added simultaneously, regulated by the cascade of genes progressively refining the pattern in blastoderm stage embryo. However, the majority of arthropod species adds segments one by one during germ band elongation. Each new segment buds off from the posterior region of the germ band, commonly called the growth zone (Peel et al. 2005; Damen 2007). This mechanism of growth is called sequential segmentation. Notch-Delta signaling plays no role in segmentation in *Drosophila* but is known to be critical in vertebrate somitogenesis. It has recently been shown to function prior to and during segmentation in a number of arthropods that employ sequential segmentation. However, whether Notch pathway genes oscillate in a clocklike fashion, the way they do in vertebrates, has not been demonstrated in arthropods. We have shown that Notch is expressed and plays a role in the crustacean *Thamnocephalus platyurus.* The next step is to look at the domain of Notch/Delta expression in very short time intervals. If Notch/Delta expression in finely staged larvae is synchronous, we are somewhat confident to say that the individual difference does not count for the pattern of Notch/Delta expression domain. And thus we can say that Notch/Delta is actually oscillating as thus working as a “segmentation clock”. And furthermore, we would explore other functions of Notch in *T. platyurus* inferred by Notch functions in other arthropod species, such as the interaction of Wnt organizer and Notch/Delta signaling.

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5.

ACQUISITION OF LUCIBUFAGINS IN FEMME FATALES OF THE GENUS *PHOTURIS*

Maddie Farrar ‘19, Bailey D’Antonio ‘18, Kathareeya Tonyai ‘17
Faculty Sponsor: Scott Smedley

Lucibufagins are a mix of defensive steroids used by fireflies to ward off predators such as birds and spiders. Not all fireflies produce their own lucibufagins, but they require it for survival so they consume other fireflies to acquire it. In the summer, female *Photuris* fireflies practice ‘femme fatale’ behavior by luring male fireflies of a different species, such as *Photinus*, using fake flash signals to consume them, presumably for their lucibufagins. The winter firefly,

Ellychnia corrusca, is closely related to *Photinus*, which is a common prey item to *Photuris*. *Ellychnia corrusca* slowly transitioned from a summer life cycle to live their adult lives in winter in order to avoid being predated upon by *Photuris*. Twenty-four lab reared female *Photuris* fireflies were separated into eight blocks of three fireflies each. Each firefly in the group was randomly assigned a feeding designation of either a female *Ellychnia corrusca* firefly, a male *Ellychnia corrusca* firefly or a *Tenebrio* beetle and were fed them each day for three days. The food samples were frozen after each day of feeding. The *Photuris* rested for two more days before being massed and frozen to await analysis. The *Photuris* fireflies that were fed *Ellychnia corrusca* contained lucibufagins ($P<0.0001$). Most of the *Photuris* fireflies that were fed the control *Tenebrio* beetle contained no lucibufagins with the exception of one. These lucibufagins are key to unlocking the pattern of evolutionary development in different firefly species. The 'femme fatale' behavior, which allows the *Photuris* firefly to ingest the lucibufagins and integrate it into its blood, is a mechanism that could have potential medical benefits. Further research is necessary to discover the biological mechanisms required to integrate the lucibufagins and use them for an extended period of time.

6.

HOW DOES ELONGATION OCCUR IN THE POSTERIOR OF SEQUENTIALLY-SEGMENTING ARTHROPODS LIKE *THAMNOCEPHALUS PLATYRUS*?

Khaoula Ben Haj Frej '18
Faculty Sponsor: Terri A. Williams, National Science Foundation

Segmentation is a key feature of arthropods. However, the model arthropod, *Drosophila melanogaster*, undergoes simultaneous segmentation whereas most arthropods undergo sequential segmentation. Both segmentation (patterned by a gene regulatory network) and elongation (mitosis, cell elongation, and movement) occur in the growth zone. We are using *Thamnocephalus platyrus* to understand the coordination of elongation with segmentation in the growth zone of the developing animal. Past measurements have shown mitosis occurs in the growth zone in an oriented manner along the anterior-posterior axis. In analyzing the role of mitosis in elongation and segmentation, two approaches were taken for this research. One approach is pharmacological and one is a gene knockdown. To study the role of mitosis, one must knock it down and study the change in the animal's elongation as a result. The first knockdown of mitosis has yet to be implemented but involves the RNAi knockdown of cyclins, which act as checkpoints to mitosis, determining whether the next step will occur or not. Thus far, two cyclins (A and B) have been cloned for *Thamnocephalus*, for future RNAi use. The second method is to use a pharmacological inhibitor, vinblastine, a chemical which halts mitosis. The body length of animals exposed to vinblastine was compared the normal animals. Thus far, blocking mitosis has stopped elongation and can be used to examine the effect of disrupting elongating on segmental patterning genes.

7.

ANALYZING THE ROLE OF EARLY SEGMENTING GENES IN A BASAL ARTHROPOD

Dwindy Gerbier ‘19
Faculty Sponsor: Terri A. Williams

Segments play a pivotal role in the body plan of arthropods. Most of what is known about segmentation is based upon research done on the model arthropod, *Drosophila melanogaster*. Although it is the model system, *D. melanogaster* is atypical in that it patterns its segments all at once, whereas the majority of the other arthropods pattern their segments sequentially. There are four classes of segmental genes, one of the early acting classes of genes, the gap genes, cause gaps in the *D. melanogaster* body plan when mutated. In an effort to understand the evolution of segmentation, and the role of gap genes in sequentially segmenting arthropods, the gap genes, hunchback, knirps, kruppel, tailless and giant, were identified and a portion of each gene was cloned from *Thamnocephalus platyurus*. A larval transcriptome was first blasted for the specific gap genes, and primers were designed and ordered for cloning. The cloning consisted of cDNA polymerase chain reaction, ligation and transformation, plate streaking which is used to obtain clones, colony polymerase chain reaction, purification, and lastly sequencing. Two different gap genes in *T. platyurus*, hunchback and knirps, have been correctly identified and successfully cloned. Further work will be to first complete the cloning of all five gap genes found in *T. platyurus*. Once the cloning is complete, further experiments are planned to investigate gene expression and function. Although gap genes have been widely studied in other groups of insects, this in depth examination is lacking in crustaceans. Our investigation will provide a greater understanding of the role of gap genes in the evolution of arthropod segmentation.

8.

GENETIC BARCODING RESOLVES THE HISTORICALLY KNOWN RED ALGA *CHAMPIA PARVULA* FROM SOUTHERN NEW ENGLAND, USA, AS *C. FARLOWII* SP. NOV. (CHAMPIACEAE, RHODYMENIALES)

Maura K. Griffith ‘17
Faculty Sponsor: Craig W. Schneider

Using mitochondrial COI-5P and choloroplast *rbc*L genetic markers, the red algal species historically known in southern New England, USA, as *Champia parvula* is found to be genetically distinct from the species to which it has historically been aligned, necessitating the description of a new species, *C. farlowii*, for plants from Rhode Island, Massachusetts, Connecticut and New York. The new species is morphologically compared with true European *C. parvula* and congeners, especially those with similar features previously aligned under the same species name. *Champia farlowii* is a morphologically cryptic species, the seventh in the expanded *C. parvula* complex, with overlapping characteristic measurements despite differences at the extremes when compared to *C. parvula*.

9.

NEW GENETIC SPECIES OF *WRANGELIA* (WRANGELIACEAE, CERAMIALES) FROM BERMUDA, WESTERN ATLANTIC OCEAN

Walter M. Jongbloed '16
Faculty Sponsor: Craig W. Schneider

Currently there are 20 accepted species in the genus *Wrangelia* from warm waters of the world's oceans with four presently known from the western Atlantic: *W. argus, W. bicuspidata, W. gordoniae* and *W. penicillata.* A recent molecular and morphological investigation separated *W. gordoniae* (type locality, San Salvador Is., Bahamas) from what it had been earlier called, *W. penicillata* (type locality, Mediterranean Sea). Using similar techniques, our barcode and phylogenetic analyses (COI-5P, SSU rDNA) indicate the presence of six species of *Wrangelia* in Bermuda, three of which appear to be novel species in the *W. penicillata* complex. Anatomical and reproductive characters, as well as their gene sequences, are used to distinguish the new genetic species. Lack of complete rhizoidal cortication in *W. argus* and *W. bicuspidata* distinguish them from the four species in the *W. penicillata* complex in Bermuda. A key to the western Atlantic species of *Wrangelia* is provided.

10.

SIMULATED PREDATION AND TAIL AMPUTATION REDUCES BRAIN CELL PROLIFERATION IN THE ELECTRIC FISH, *BRACHYHYPOPOMUS*

Geoffrey Keane '16, Michael Ragazzi '16
Faculty Sponsor: Kent Dunlap

The brain is shaped both positively and negatively by the external environment. In natural populations of electric fish (*Brachyhypopomus*), fish living among a high density of predatory catfish (*Rhamdia*) and experiencing tail injury had lower rates of forebrain cell proliferation than fish living among a low density of predators and with intact tails. We tested the causal relationship between predator stress and reduced rates of cell proliferation by experimental tail amputation and simulated predation in the laboratory. We identified cell proliferation in the forebrain and midbrain through immunohistochemical localization of Proliferating Cell Nuclear Antigen (PCNA). Both experimental tail amputation and simulated predator exposure decreased brain cell proliferation in the forebrain, but neither treatment affected the midbrain. These results demonstrated that somatic injury and psychological stress cause regionally specific inhibition of brain cell proliferation, and suggests that similar predator stress in the wild indeed causes decrements in forebrain cell proliferation.

11.

FETAL MEMBRANE ULTRASTRUCTURE AND DEVELOPMENT IN THE PUEBLAN MILKSNAKE, *LAMPROPELTIS TRIANGULUM* (COLUBRIDAE)

Young K. Kim '17
Faculty Sponsors: Daniel G. Blackburn, Yunming Hu

In reptiles, fetal membranes maintain the developing embryo by providing oxygen, water, and eggshell calcium. We used scanning electron microscopy to reveal anatomical and developmental features of these structures in the Pueblan Milksnake, *Lampropeltis triangulum.* In early developmental stages, two fetal membranes line the eggshell: the chorioallantois and the

yolk sac omphalopleure. Both membranes are initially lined externally with small protrusions (microvilli) that increase the area for water uptake. However, the chorioallantois becomes specialized for respiratory gas exchange through proliferation of blood vessels and thinning of its external cellular lining. The yolk sac regresses as the chorioallantois expands to surround the entire egg, maximizing the area for oxygen uptake. Allantoic fluid serves as a water reservoir for the egg, and we postulate that it facilitates water uptake by establishing an osmotic gradient. Comparison to other species studied in our lab and the literature suggests that the developmental pattern in milksnakes is widespread and represents an ancestral condition for snakes.

12.
DOES GUT FLORA CHANGE IN A MOUSE MODEL OF AUTISM SPECTRUM DISORDERS ON A KETOGENIC DIET?

Shelby Labe ‘16
Faculty Sponsor: Lisa-Anne Foster

The normal bacterial flora of an organism includes the non-disease causing bacteria that inhabit the human body under normal conditions. These bacteria are important for numerous reasons; for example, they excrete vitamins and prevent colonization by pathogens. Autism spectrum disorders (ASD) are neurodevelopmental disorders that are characterized by difficulties in communication and social interaction. Comorbid conditions including gastrointestinal (GI) issues, depression, and anxiety are common. One popular way to attempt to alleviate the behavioral symptoms of ASD is maintaining a ketogenic diet, which is seventy-five percent fat. Such a diet induces ketosis, a metabolic state when ketone bodies, not glucose, are used as the primary fuel. This study analyzes how the ketogenic diet affects the GI flora in a mouse model of ASD and aims to determine if the benefits of a ketogenic diet are correlated with changes in the gut flora. In order to determine the types of bacteria present, the 16s rRNA gene was amplified from the fecal samples of mice in treatment groups. The amplified DNA was then digested with restriction enzymes (*Hae*III) and terminal Restriction Fragment Length Polymorphism (tRFLP) electropherograms were generated. Analyses of the electropherograms suggest there is no significant difference in number of species present or abundance of bacteria between any pre and post diet conditions, except for the normal mouse on a ketogenic diet. Additionally, there are 28 unidentified bacterial species that are common between two or more of the four experimental groups.

13.
WITHDRAWN

14.
A NOVEL PATTERN OF YOLK MOBILIZATION IN DEVELOPING SCALED REPTILES

Kathryn G. Powers ‘17
Faculty Sponsors: Daniel G. Blackburn, Yunming Hu

Corn snakes (*Pantherophis guttatus*) serve as a valuable model for developmental studies. Unlike birds, which employ a well-vascularized yolk sac to transport nutrients to the embryo, corn snakes use an elaborate network of blood vessels that penetrate into the yolk mass itself. In

this study, we have used light microscopy and scanning electron microscopy (SEM) to image yolk samples from eggs of mid to late developmental stages. Our observations have revealed how the large yolk mass is vascularized, cellularized, and mobilized for embryonic use. Yolk nutrient transport begins with the proliferation of endodermal cells that fill with yolk droplets and form elongated cords of interconnected cells. As embryonic development progresses, new blood vessels within the yolk mass become encased in these cells which in turn allow the products of yolk digestion to be transported back to the developing embryo. Our lab has found that this unusual mechanism of yolk cellularization and mobilization occurs in other snakes as well as lizards and may be ancestral for scaled reptiles. Studies of this developmental mechanism offer information on patterns from which live-bearing reproduction has evolved and contribute to an understanding of reptilian evolutionary history.

15.

THE CASE FOR TRUE MORPHOLOGICAL CRYPSIS: PACIFIC *DASYA ANASTOMOSANS* AND ATLANTIC *D. CRYPTICA* SP. NOV. (DASYACEAE, RHODOPHYTA)

Phong Quach ‘17
Faculty Sponsor: Craig W. Schneider

With the advent of routine genetic barcoding for taxonomic distinction a decade ago, descriptions of morphologically cryptic species have exploded in the macroalgal literature. Produced either by convergence of morphological characteristics for geographically distant species, or divergence of species from a common ancestor, cryptic species often can be distinguished by subtle anatomical or reproductive features. Some species pairs, however, remain indistinguishable with overlapping characteristics even upon close inspection. Such a case is demonstrated for two species differentiated by sequences of a portion of the *rbc*L chloroplast gene, *Dasya anastomosans* from the Indo-Pacific, and *D. cryptica* sp. nov. from the western Atlantic. After assembling morphological and anatomical data for the two species, no significant differences were detected between them, thus affording the usage of the epithet for the new species from a distant ocean basin than its congener.

16.

THE INVESTIGATION OF GLOBAL PLANAR CELL POLARITY MOLECULES ON GERM-BAND ELONGATION OF *TRIBOLIUM CASTENEUM*

Phong Quach ‘17, Cole Eskridge (University of Arizona)
Faculty Sponsors: Terri A. Williams, Lisa Nagy (University of Arizona)

The success of arthropods as the largest animal phylum on earth may be attributed to their segmented body plan. Despite the extensive knowledge of segmentation and embryonic elongation in the well-known model system, *Drosophila melanogaster*, such findings cannot be used to generalize for all arthropods’ developmental scheme since segmental patterning and elongation are largely separate in flies. Most members of the Arthropoda phylum, such as *Tribolium casteneum*, coordinate segmentation and germband elongation during development. Despite the mechanistic understanding of segmental patterning in the beetle, the connection between the segmental patterning and cell behavior underlying germ-band elongation in *T. casteneum* is not well-understood. In order to have successful body elongation, cells must be polarized and somehow coordinated along the body axis for extension. Global planar cell

polarity (or PCP) components are known for polarizing the epithelium of fruit fly and orient the polarity of ommatidia by generating distribution gradient along the body axis. Knocking down global PCP gene products, Fat and Dachsous, have known to effect germ-band elongation of *T. casteneum*. However, the exact mechanism for such defects have not been dissected. In order to understand the role of PCP pathway in Tribolium's germband development, the gene of Fat and Dachsous were cloned and used to produce dsRNA to knockdown expression of those genes. A series of experiment were done to optimize the RNAi experiment. Finally, RNAi injection experiments of Fat and Dachsous gene was conducted on Tribolium female pupae and the phenotype of the embryo was recorded. We hope to further dissect the importance as well as possible molecular mechanism of how these global PCP molecules involve in *T. casteneum* body development.

CHEMISTRY

17.

LARGE SCALE SYNTHESIS OF A CONSTRAINED BIS-ALKYNE COMPLEX

Ashira Anderson '16
Faculty Sponsor: Timothy P. Curran

In 2011, the Curran lab discovered a novel, bimetallic, air-stable, constrained cyclic molecule. The molecule features a 1,1'-ferrocenediakynylamide in which the two alkynes form a bis-alkyne complex with tungsten. Current research investigates whether derivatives of the constrained cyclic molecule induces formation of a β-sheet conformation. Peptides with β-sheet conformations are of interest because they are thought to be associated with amyloid diseases such as Alzheimer's. Last semester's research focused on resynthesizing the constrained tungsten bis-alkyne complex on a large scale and for the sample to be sent off for X-ray crystallography with our collaborators at Fairfield University. Approximately 91 mg of the constrained cyclic molecule was synthesized. This semester an attempt was made to synthesize a similar constrained cyclic molecule where molybdenum replaces the tungsten. Details regarding the preparation of these molecules will be presented.

18.

THE CHARACTERIZATION OF PROTEIN BINDERS IN ARTISTS' MATERIALS USING DART-TOF MS

Jacqueline Busa '17
Faculty Sponsor: Henry DePhillips

The field of art conservation of original works of art such as easel paintings requires the analysis of pigments, binders and resins used by artists. This study is a continuation of previous studies using Direct Analysis in Real Time – Time of Flight Mass Spectrometry (DART-TOF MS) to characterize resin and oil binders. In this study, protein binders commonly found in paintings are characterized by applying statistical analysis to the patterns displayed in their mass spectra. Samples of casein binder and egg tempera binder were aged at 80^{o}C for at least 500 hours. Mass spectra were obtained and the patterns in their m/z spectra were subjected to linear discriminant analysis and cluster analysis. Clearly defined domains were found for each protein that will enable identification of these protein binders in easel paintings.

19.

SYNTHESIS AND CHARACTERIZATION OF RHENIUM PHOSPHINE COMPLEXES

Alexandra Cocco ‘16
Faculty Sponsor: Maria Parr

Rhenium complexes have a number of important applications such as catalysis, photophysical activity, and the development of radiopharmaceuticals. Three bidentate phosphine ligands were used in the synthesis of rhenium-oxo phosphine complexes. The three ligands used, Cl-OMe-biphep, t-Bu-XANTPHOS, and phanephos, are wide-bite angle bidentate phosphine ligands, which are an important type of ligand for many types of applications. A rhenium-oxo precursor, $[ReOCl_3(AsPh_3)_2]$, was used in the reactions with each of the three ligands. The reactions with Cl-OMe-biphep and phanephos were successful as determined by color variations in products, FTIR, and multinuclear NMR spectroscopic characterization. The reaction with t-Bu-XANTPHOS produced an intractable product and was deemed unsuccessful. Additional work with this ligand is underway in order to determine the reason for the lack of coordination.

20.

MICROFLUIDIC CHEMICAL CYTOMETRY OF FLUORESCENT REPORTERS IN *DICTYOSTELIUM*

Casey Crowley ‘19
Faculty Sponsor: Michelle L. Kovarik

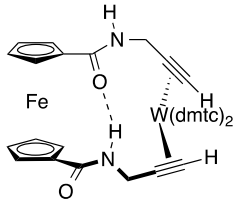
The chemical contents of a single cell can be detected using chemical cytometry. The detection of different concentrations and forms of fluorescent substrate reporters and dyes provide information about specific enzyme activity, cell pH, and oxidative stress. We plan to use diacetate derivatives of fluorescein-based dyes to report on cell status; however, *Dictyostelium discoideum* possesses organic anion transporters that remove commonly used fluorescent dyes from the cell. We used 5 mM probenecid to inhibit exporters and thereby retain the fluorescein and carboxyfluorescein products in *Dictyostelium* cells. We compared the fluorescence intensity of *Dictyostelium* cells when dyes were loaded and washed with complete development buffer (DB); loaded with complete DB and washed with 5mM probenecid; and washed and loaded with 5 mM probenecid in complete DB. We determined that *Dictyostelium* retained the highest dye concentrations when the dyes are loaded and the cells washed with 5mM probenecid (median fluorescence intensity = 233), suggesting the least organic anion transporter activity compared to the other techniques (37 and 39 fluorescence units, respectively). The higher fluorescence intensity of substrate reporters will permit measurements of pH and/or oxidative stress at the level of single cells. On-going work includes optimizing conditions for on-chip lysis of *Dictyostelium* for chemical cytometry.

21.

CHARACTERIZING THE STRUCTURES OF POSSIBLE FERROCENE-TUNGSTEN CONSTRAINED BETA-SHEET MIMETICS

Lauren Davidson ‘16
Faculty Sponsor: Timothy P. Curran, National Science Foundation

A bimetallic, constrained ring system of a 1,1’-disubstituted ferrocene and a cyclic tungsten bis-alkyne (**1b**) has been discovered. The molecule adopts a van Staveren conformation for hydrogen-bonding within the ring, where only one of the two amide NH protons is involved in an intramolecular hydrogen bond (**1a**); however, a system that adopts a beta-sheet conformation with both NH protons involved in an intramolecular hydrogen bond has not yet been discovered. If hydrogen-bonding between the peptide strands can be achieved, the system will represent a model system for beta-sheets. Such a structure might be used to study potential biological activity as a highly specific drug for beta-sheet protein-related diseases such as Alzheimer’s. Synthesis of the bimetallic constrained ring system (**1b**) required three steps consisting of highly pure intermediates, ultimately coordinating a ferrocene bis-alkynylpeptide to a tungsten complex, $W(CO)_3(dmtc)_2$. Ring closure was achieved by displacing three carbonyl ligands on the tungsten and opening coordination sites for the alkynes of the ferrocene complex, yielding a characteristically yellow solid (**1b**). Results were confirmed using ^1H NMR (400 MHz, $CDCl_3$), COSY NMR (400 MHz, $CDCl_3$), ^1H NMR DMSO titration, HPLC, and ES-MS. Work is currently underway to prepare a similar bimetallic ring with an aniline-valine adduct (**1c**), using the same procedure, to investigate the role of amino acid structure in possible hydrogen-bonding. Future work will involve synthesis of complexes with adducts containing sp^3-hybridized carbons attached to the benzene ring in the peptide chain, in order to determine if removing the aniline amine will form a beta-sheet mimetic by allowing hydrogen-bonding between the peptide strands.



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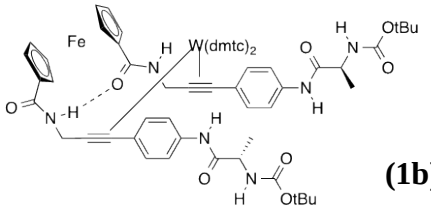

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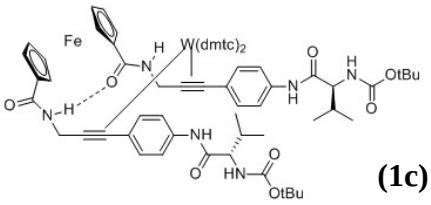

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22.

SYNTHESIS OF ALKYNYL DERIVATIVES OF 1,1’-DISUBSTITUTED FERROCENES

Florence Dou ‘16
Faculty Sponsor: Timothy P. Curran

Previous studies have indicated that peptide bisalkynes can be readily coordinated to tungsten to form cyclic complexes with multiple conformations. When ferrocene was introduced into the ring, a complex with a single conformation was discovered. Therefore in this study, further alkynyl derivatives of 1,1’-disubstituted ferrocene were pursued. In the first project, a multistep synthesis of a di-ferrocene bisalkyne symmetric macrocycle was attempted via two pathways. The first three steps were successful – synthesis of the butyne diamine, protection of the diamine with Boc-group and subsequent removal of the protecting group. However, the final coordination

to ferrocene was unsuccessful. In the second project, a multistep synthesis of an ether derivative of ferrocene bisalkyne was attempted. The first step was a reduction of ferrocene dicarboxylic acid to the dialcohol. The product was analysed by ^{1}H NMR spectroscopy and electrospray mass spectrometry. Details about this synthetic work will be presented.

23.

THE EFFECT OF SURFACTANTS ON SUPPORTED BILAYER MEMBRANES IN MICELLAR ELECTROKINETIC CHROMATOGRAPHY

Jessica Duong ‘19
Faculty Sponsor: Michelle L. Kovarik

Despite regular usage of supported bilayer membranes (SBMs) in capillary zone electrophoresis, there are no reports of their usage in micellar electrokinetic chromatography (MEKC), which uses surfactant in the buffer. Thus, in order to clarify the effect of surfactant on SBMs, the effect of sodium dodecyl sulfate (SDS) on bilayers of 1-palmitoyl-2-oleoyl-*sn*-glycero-3-phosphocholine (POPC) was investigated. Concentrations of SDS were utilized at values below (1mM) and above (10 mM) the critical micelle concentration in tris-HCl run buffer. The POPC coating durability was tested by monitoring the electrokinetic migration of carboxyfluorescein and fluorescein dyes in polydimethylsiloxane (PDMS) microfluidic devices. The presence of the zwitterionic coating suppressed electroosmotic flow, allowing the anionic dyes to electrophorese toward the anode; coating failure was evidenced by slowing migration times and/or migration of the anionic dyes toward the cathode due to electroosmotic flow originating at the bare PDMS surface. In control microchips, with no SDS present, the dyes injected towards the anode and were detected for about 2 hours before coating failure. With SDS present, the polarity of the electrodes had to be reversed in order to inject the dyes. In particular, the coating was immediately removed with 10 mM SDS, and the dye injected electroosmotically. The coating was partially removed with 1 mM SDS initially, such that the electrophoresis of the dyes and the electroosmotic flow of the fluid were roughly equal and neither dye exited the sample reservoir. Over the course of about 20 minutes, the coating was further removed so that electroosmotic flow became dominant and the dye finally injected. These results suggest that MEKC using SDS as a surfactant is not possible with uncrosslinked SBM coatings. Further work will be directed towards investigating the effect of nonionic and cationic surfactants on SBMs.

24.

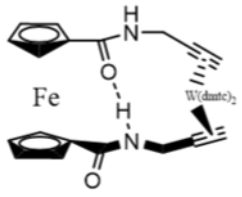
SYNTHESIZING A DIPEPTIDE CONSTRAINED IN AN ANTI-PARALLEL β-SHEET CONFORMATION THROUGH TUNGSTEN COORDINATION

Paul Handali ‘18
Faculty Sponsor: Timothy P. Curran

Tungsten is a transition metal with the capacity to form air stable complexes with alkyne ligands. It potentially can be coordinated to dialkynyl peptide ligands to form metallacyclic peptides in a β-sheet conformation. Prior work has shown that most of these metallacyclic peptides are not constrained to a single conformation, but rather a multitude of possible isomers. Due to this flexibility, ferrocene was then added to the compounds in the hopes of inducing more rigidity in the peptide conformation. Recently in the lab, **1** was discovered to be a novel constrained

molecule as it only adopts one conformation. Since this discovery, much work has been done on synthesizing and characterizing derivatives of **1**. One derivative that is currently being synthesized is **2,** an alanine derivative. Details of its synthesis will be presented in this poster.

Novel Constrained Molecule **Alanine Derivative**



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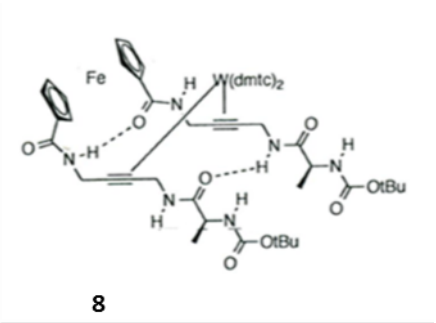

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25.

DETECTION AND DISCRIMINATION OF COUNTERFEIT PHARMACEUTICALS USING DART-TOFMS

Jacqueline Kromash ‘19, Thomas Naragon ‘17
Faculty Sponsors: Janet Morrison, Brian F. Donnelly, Amy C. Callanan, Pfizer

Counterfeit pharmaceuticals are increasing in both popularity and availability, which poses dangerous health risks to patients and results in significant revenue losses for pharmaceutical companies. Viagra® (sildenafil citrate) is one of the most commonly counterfeited drugs. The goal of this project is to develop a fast and reliable method using direct analysis in real time—time of flight mass spectrometry (DART-TOFMS) combined with multivariate statistical analysis to determine drug authenticity and distinguish manufacturing source.

DART-TOFMS is advantageous because it provides immediate results without the need for sample preparation. In this study, mass spectra were obtained in triplicate on authentic Viagra® tablets as well as 85 pills obtained in ten separate counterfeit drug seizures. In-source collision induced dissociation (CID) was performed at MS inlet voltages of 20, 30, 60, 90, and 120V, and the resulting MS chemical signature data were processed using multivariate statistical methods. The potential of this methodology for distinguishing authentic and counterfeit pharmaceuticals, as well as for discriminating manufacturing source, will be discussed.

26.

UTILZING THE DART-TOFMS IN ORGANIC CHEMISTRY LAB

Shawn McCoy ‘16
Faculty Sponsor: Timothy P. Curran

The practicality of using Direct Analysis in Real Time-Time of Flight Mass Spectrometry (DART-TOFMS) in organic chemistry lab was tested in this research project. Laboratory sessions are investigative in nature as students are often tasked to synthesize unknown compounds containing functional groups that they’ve recently learned in lecture. To determine the identity of their compound, infrared spectroscopy, proton and carbon NMR, and gas chromatograph mass spectrometry (GC-MS) are presently utilized. The DART is an instrument

capable of determining the molecular mass of a compound with several advantages over GC-MS. First, students are more integrated in the scientific discovery process as they can operate the DART themselves with minimal supervision and training. Second, the DART uses a soft-ionization technique, which adds a proton to the analyte of interest making it more likely that the M+H (mass plus a hydrogen) peak will be obtained. Lastly, the DART is a highly precise instrument, giving mass values to thousandths place. This research project examined the compounds containing the functional groups that organic students would encounter in laboratory settings including alcohols, acids, carbonyl compounds to name a few. After varying settings to produce the most optimal mass spectra, temperature was set at 300 C, orifice 1 at 20 V, peaks voltage at 800 V and detector voltage at 2200 V. With these settings and knowledge of the expected ionization patterns for the various functional groups analyzed, organic samples from students in organic lab were successfully analyzed. The M+H peak of the compound was found through systematic assessment of the mass spectra peaks. Future work on this project will look to generate interoperator reliability and draft a protocol that all operators can follow. Additionally, the efficacy of analyzing the compounds can constantly be improved to yield faster results.

27.

URIC ACID AND ITS METABOLITES AS POTENTIAL CONVENIENT BIOMARKERS OF PARKINSON'S DISEASE

Nikola Mizgier '19
Faculty Sponsor: William H. Church

Uric acid is a neuro-protectant diminishing the amounts of superoxide, peroxynitrite, and nitric oxide via their conversion into allantoin, triuret, and 6–aminouracil, respectively. Along with its metabolites, uric acid is a potential biomarker of Parkinson's disease. Capable of crossing the blood-brain barrier, these compounds promise a method of monitoring the disease's progression via assessment of their concentrations in the brain by a simple blood analysis. The development of an accurate analytical method for these concentrations, using an LCQ mass spectrometer (MS), is being attempted by manipulating the composition of samples' medium and parameters of the instrument. High concentration samples of the analytes were prepared in dH_2O, 0.1% formic acid (FA), and in 0.09% FA to assess the effect of pH on the spectra's quality. Then a set of 100-fold diluted samples in dH_2O and 0.1% formic acid was prepared to address issues with analyte solubility inside the mass spectrometer sample inlet. All five sets of samples were run on the tuned instrument with a detection range 50-200 Da. For each sample, collision energy, flow rate, and pressures of the sheath and auxiliary gases were manipulated to optimize the ion current. Before the spectra were collected, all parameters were returned to default settings. The obtained spectra were compared to assess the effectiveness of each manipulation based on the presence of expected peaks and the stability of the ion count. Varying the concentration of formic acid in samples' medium or parameters' manipulations had no noticeable effect on either accuracy of observed peaks or the ion current; and neither had varying concentrations of the analytes. Other manipulations have to be applied in order to optimize the MS detection of the compounds. Further, these sets of samples will be analyzed using an HPLC with a Diode-Array Detector in order to acquire additional data.

28.

STUDY OF THE CONFORMATION AND STRUCTURE OF 1,4 – DIHYDROXY – 2-BUTYNE AS THE FOUNDATION FOR THE STUDY OF β – SHEET PEPTIDE

Vu Nguyen ‘17
Faculty Sponsor: Timothy P. Curran

Alzheimer’s disease has always been known as a type of dementia that cause memory loss, decline in mental and cognitive ability. One of the two possible causes of Alzheimer’s disease is plaques which are the deposits of beta – amyloid in the space between nerve cells. Beta – amyloid deposits form because this protein has a β – sheet structure that makes it insoluble in aqueous solution and makes the protein aggregate. The main objective of this research is to develop a model system for β – sheet where solubility and aggregation can be studied. In particular, we will study the conformation and structure of a derivative of 1,1’ – ferrocene linked to 1,4 – dihydroxy - 2 – butyne as model system for the study of β – sheet peptides. During this semester, the first step of the reaction, a coupling of 1,1’ - ferrocene diacid chloride with an alkyndiol was conducted. The product of the reaction was then purified and indentified with ^{1}H NMR and mass spectrometry. Details about this reaction will be presented.

29.

COMPUTER ASSISTED DRUG DESIGN: TOWARDS THE DISCOVERY OF NEW ANTIBIOTICS

Lauren Ollerhead ‘18
Faculty Sponsors: Amy Anderson, Vindya Thilakarathne

Bacterial infections caused by Gram-negative bacteria species such as *Pseudomonas aeruginosa*, *Escherichia coli* and *Acinetobacter baumannii*, have become an increasing threat to recent public health. Our project aims to utilize computer aided drug discovery to discover new drug molecule targeting key enzymes present in Gram-negative bacteria. Metal binding enzymes, LpxC, PDF and DXR play pivotal role in biochemical reactions in bacterial cell, causing them to become major targets in novel antibiotic development. Our goal is to identify and evaluate new chemotypes that include metal chelating groups intended to bind intracellular metalloenzyme targets. A small library of α and β substitute tropolone ligands were used in this study and docking studies were performed against metalloenzyme targets. The readily ionizable α-hydroxy tropone functionality imparts an ability of the compounds to associate strongly with metal ions. The docking results were compared with minimum inhibitory concentration values (MIC), to identify potential metal enzyme that tropolones interact.

30.

THE INVESTIGATION OF TURBOMYCIN B ANALOGUES FOR ANTIBIOTICS DEVELOPMENT

Phong Quach ‘17
Faculty Sponsors: Cheyenne Brindle, Lisa-Anne Foster

The scarcity of new antibiotic agents combined with the rapid rise of antibiotic resistant bacteria in recent years necessitates the development of novel antimicrobial compounds. From a metagenomic study conducted in soil bacteria, turbomycin B was found to display a broad spectrum of antibiotic effects toward both Gram positive and Gram negative bacteria. Despite the

promising activity of the compound, it's structure-activity relationship was not well known. By creating analogues of turbomycin B, the effects of the modification of the indole and aldehyde portions of the compound on its biological activities were investigated. Thus far, we have synthesized an array of analogues to investigate the steric and electronic effects of the phenyl and the indole components. The compounds were tested on a variety of bacterial strains to assess their activities. Alkylation of the N-H indole adduct increased the antimicrobial property of the analogues.

31.

PREPARATION OF ALKYNE PEPTIDE DERIVATIVES THAT ADOPT A PROPOSED BETA SHEET CONFORMATION WHEN COORDINATED TO TUNGSTEN

Joseph P. Sanderson-Brown '18
Faculty Sponsor: Timothy P. Curran

Dialkynyl peptides that are bonded to ferrocene and of certain chain lengths have been shown to cyclise into bimetallacyclic complexes when coordinated to tungsten. The molecule 1,1'-ferrocenedialkynyldiamide has further been shown to adopt an anti-parallel β-sheet conformation when cyclised using tungsten. The intramolecular bonding between the amide groups of the peptide chains determine the conformation and orientation adopted. Alanine and phenylalanine peptide derivatives of 1,1'-ferrocenedialkynyldiamide were analysed to determine if a similar β-sheet conformation could be adopted. A commercially available alanine derivative, Boc-Ala-OSu, was reacted with 1-amino-4-chloro-2-butyne under basic conditions (Et_3N) in an attempt to form Boc-Ala-$NHCH_2CCCH_2Cl$. The reaction was unsuccessful. A commercially available phenylalanine derivative, Boc-Phe-Np, was reacted with 1-amino-4-chloro-2-butyne under basic conditions (Et_3N) to yield Boc-Phe-$NHCH_2CCCH_2Cl$. The chlorine of the Boc-Phe-$NHCH_2CCCH_2Cl$ was substituted via reaction with sodium azide (NaN_3) in tetrahydrofuran and water for 24 hours. Ground triphenylphosphine (PPh_3) was added and the reaction flask left to stir for a further 24 hours to convert the azide group into an amine. The success of the reaction is still unknown as the product is yet to be isolated. The structures of the reaction products were confirmed using electrospray mass spectrometry and proton NMR spectroscopy. If the product Boc-Phe-$NHCH_2CCCH_2NH_2$ forms and is isolated, the sequential synthesis step will be reacting the amine with a diacid chloride source of ferrocene followed by coordination to tungsten. The bimetallic complex will be analysed using NMR to identity the conformation and orientation adopted.

32.

THE EFFECTS OF AN ORGANIC LIQUID ON THE SURFACE TENSION OF SALT SOLUTIONS

Adam Thibodeaux '18, Julia Clapis '18, Tuizhi Yu '16
Faculty Sponsor: Maria Krisch

The liquid vapor interface of a solution is a chemically interesting area, because it is an asymmetric environment. It is known that many organic species in aqueous inorganic salt solutions significantly alter the surface concentrations of the solutions they are in, because of interactions of the species at the surface. The surface tension of these mixed aqueous organic and inorganic salt solutions allows for indirect observation of the surface and how it changes. This allows us to infer, through the use of the Gibbs equation, the amount of excess organic species at

the liquid vapor interface. The system under study is chloroiodomethane in aqueous sodium chloride solution. Both of the two component solutions, aqueous sodium chloride and aqueous chloroiodomethane, show significant increase in surface tension in comparison to pure water. The surface tension of the three component solution was measured using the Wilhemy plate method. These measurements show either mild surface depletion or mild surface enhancement.

33.

INTERSPECIES COMPARISON OF DEGRADATION OF A PEPTIDE SUBSTRATE REPORTER

Allison J. Tierney '17, Kunwei Yang '17
Faculty Sponsors: Brooks K. Emerick, Michelle L. Kovarik

Peptide substrate reporters are fluorescently labeled peptides that can be acted upon by one or more enzymes of interest. Peptide substrates are generally easier to work with than full-length protein substrates; however, they can be degraded by peptidases. As a result, peptide reporters must be made resistant to proteolysis in order to study enzymes in intact cells and lysates. This is typically achieved by optimizing the reporter in a single cell type or model organism. We are adapting a peptide substrate reporter for protein kinase B (PKB) that was developed in human cells for use in common model organisms. We are measuring peptidase activity toward the peptide VI-B in *D. discoideum*, *S. cerevisiae*, and *E. coli* using capillary electrophoresis with laser-induced fluorescence (CE-LIF). We found VI-B to be stable in *D. discoideum* ($t_{0.5} \approx$ 92 min) and *S. cerevisiae* ($t_{0.5} \approx$ 330 min). This data set suggests VI-B is sufficiently stable for PKB assays in *D. discoideum* and *S. cerevisiae*. Using compartment-based modeling, we can quantitatively determine how VI-B peptide fragments form due to peptidase activity. In *D. discoideum* and *S. cerevisiae*, we discovered VI-B reporter fragments form mainly from the full-length parent peptide sequence rather than from other developing peptide fragments. Future work includes running *E. coli* lysates in biological triplicate to determine if VI-B is a stable reporter for this organism. We can then make interspecies comparisons between *E. coli*, *D. discoideum* and *S. cerevisiae* in hopes of demonstrating the potential use of compartment-based modeling in a wide variety of peptide substrate reporter design.

34.

QUANTITATIVE ANALYSIS OF SYNTHETIC CATHINONES IN ORAL FLUID USING SOLID PHASE MICROEXTRACTION (SPME) COMBINED WITH DIRECT ANALYSIS IN REAL TIME-TIME OF FLIGHT MASS SPECTROMETRY (DART-TOFMS)

Kathryn Tully '16
Faculty Sponsors: Janet F. Morrison, Brian Musselman, IonSense

Synthetic cathinones or "bath salts" have emerged as a new class of designer drugs that are marketed as "legal" alternatives to ecstasy because they produce similar euphoric and stimulant-like effects. Because they are easily attainable, the prevalence of synthetic cathinones has increased immensely over the last decade, driving the need for the development of a reliable and quantitative analysis of cathinones in biological samples. The current study explores the use of solid phase microextraction combined with DART-TOFMS for the rapid quantitation of synthetic cathinones in oral fluids. The range of limits of detection was between 6-19 ng/mL in saliva for the target analytes (mephedrone, flephedrone, methedrone, diethylpropion, methylone, and MDPV), while the range of limits of quantification was between 18-62 ng/mL in saliva. Data

involving phase polarity, salinity and pH effects on extractability will also be presented. The results of this study demonstrate the potential of DART-TOFMS as a laboratory confirmation method for oral fluid drug testing.

35.
MEASURING THE PHOSPHORYLATION OF A PEPTIDE REPORTER BY *DICTYOSTELIUM* PKB
Kunwei Yang ‘17, Allison Tierney ‘17
Faculty Sponsor: Michelle L. Kovarik

Protein kinase B (PKB) is an important regulator in cellular responses, such as cell growth, protein synthesis and cell survival under stress. The function of the kinase requires the activation of the PI3K and PKB pathway, which is conserved across many eukaryotic cell types, including our model organism, *Dictyostelium*. In the early stage of *Dictyostelium*’s social development cycle, nutrient deprivation leads to chemotactic aggregation mediated by PKB activity. To assess the activity of the kinase during development, a peptidase-resistant synthetic peptide reporter, VI-B, can be mixed with activated PKB, and the reaction progress is measured by capillary electrophoresis with laser-induced fluorescence (CE-LIF). However, several challenges must be addressed before applying this reporter to *Dictyostelium* cell lysates. PKB expression is initiated when cells enter a period of starvation and are stimulated by pulsatile cAMP signaling. Published procedures starve cells for 5 h and begin cAMP pulsing after 1h. Following each cAMP pulse, PKB activity peaks after 10-15 seconds then rapidly decreases; therefore, a quick lysis procedure is needed. Further, the activation of PKB requires the phosphorylation of two amino acids, so maintenance of the active state in a lysate requires steady inhibition of phosphatases. This presentation will address our current progress toward meeting these challenges and successfully monitoring PKB activity during *Dictyostelium* development.

COMPUTER SCIENCE

36.
COVERT COMMAND AND CONTROL CHANNEL
Luke Bradford ‘16
Faculty Sponsor: Peter A. Yoon

A Covert Command and Control Channel is a cyber attack asset that provides cyber attackers with abilities critical for winning a cyber engagement. Control of cyberspace is becoming the deciding factor of modern conflicts. In order to gain the upperhand, it is important to have a plethora of cyber attack assets. A Covert Command and Control Channel is the perfect cyber attack asset. Covert Command and Control Channels allow attackers to remotely and covertly issue commands to enemy computers. This project implemented a channel that uses Twitter to enable undetected communication between the attacker’s computer and enemy computers. When the attacker issues a command, it is sent as a tweet to a Twitter page. Enemy computers check the Twitter page for new tweets containing the attacker’s commands. If an enemy computer finds a new command, it executes the command and sends notification to the attacker.

This Covert Command and Control Channel gives attackers familiar command line interaction with an enemy computer. Command line interaction is simple to use, yet it provides attackers

with a wide array of critical abilities. Using the channel, attackers can access much of the functionality provided by the command prompt such as issuing commands, navigating directories, and viewing the contents of files. Undetected command line interaction with an enemy computer provides the means for stealing sensitive information, surveillance, and disrupting of services. These are important capabilities for winning a cyber engagement. This channel underwent several rounds of testing in a simulated environment comprised of two virtual machines. One machine simulated the attacker's machine, and the other simulated the enemy computer which received and executed commands sent by the attacker's machine. Testing showed the channel to be reliable, user friendly, and effective.

37.
RANDOM WALKS ON EXPANDER GRAPHS
Yicheng Shao '16
Faculty Sponsor: Takunari Miyazaki

Expander graphs are families of graphs that are both highly connected and sparse. Such graphs allow many nodes to communicate with one another using least resources. Expander graphs are also effective tools to mimic randomness. In particular, random walks on graphs define stochastic processes of selecting series of vertices in which every vertex is chosen uniformly from the neighbors of its previous vertex.

The objective of this project is to improve pseudorandom number generation by performing random walks on expander graphs. Since pseudorandom numbers are not truly random, all sequences of pseudorandom numbers have repeating patterns. The length of repetition is called the period length, and the quality of pseudorandom numbers can be measured by such a length. In this project, we increase the period lengths of sequences of pseudorandom numbers by performing random walks on expander graphs.

In this project, we focused on 3-regular graphs (in which all vertices have exactly three neighbors). Our experimental results show that performing random walks on expander graphs can increase the period lengths of the original sequences of pseudorandom numbers up to 500 times.

38.
TRACKRECORDRACE
Claudia Trafton '16
Faculty Sponsor: Madalene Spezialetti

TrackRecordRace is a mobile application that allows runners to record statistics about their individual runs, record and view their results, as well as challenge other runners to races via the app. This app was developed with the intention of using technology to motivate smartphone users to stay in shape by running. While some people are motivated by seeing their individual results, others are motivated by competition with others. Having these important functionalities makes running a fun, interactive, and social experience.

TrackRecordRace tracks and stores distance, speed, average pace and calories of each run conducted by the user and stores it in the cloud. Additionally, while running, users can view

a map of their path as well as their speed in real time. When they complete a run, they can view the statistics on that run. A user may challenge another user to a race by going for a Challenge Run, and then selecting a friend to challenge. This friend will receive a push notification on their device informing them of the challenge request. They can then complete the challenge on their own time. When the challenged user reaches the distance they received, the software will decide a winner based on the times sent in by both users. Both users will be notified of their win or loss.

The application was intentionally designed to be user friendly. The layout was created to the Google Material Design specifications as well as makes use of the views provided within the library. The application alsorelies on Google's Fused Location API to ensure accuracy in distance, speed, and map coordinates.

No matter what motivates you, TrackRecordRace provides you the tools to get you in running shape with a sleek and user-friendly app that will change your running experience.

ENGINEERING

39.

DEVELOPMENTAL DIFFERENCES OF DIMENSION COMPLEXITY OF HIPPOCAMPAL EEG DURING REM SLEEP

Mariam Avagyan '18, Prawesh Dahal '18
Faculty Sponsors: Taikang Ning, J. Harry Blaise

This study uses spectral analysis and correlation dimension index to examine the developmental differences between the two primary hippocampal subfields that generate the theta rhythm – the pyramidal layer at cornu ammonis (CA1) and the granule cell layer at dentate gyrus. The study focuses on the hippocampal EEG during the vigilance state of REM sleep in freely moving rats of 15 and 90 days of age. Power spectra, magnitude-squared coherence, and correlation dimension of the REM sleep EEG were estimated. The correlation dimension adds a new interpretation from the nonlinear dynamics perspective. In our study, we found that there are no significant developmental differences between the pyramidal cells of area CA1 and granule cells of the dentate gyrus when the theta activity was present during REM sleep.

40.

MEASUREMENT OF BICUSPID AORTIC HEART VALVES THROUGH DIGITAL IMAGE PROCESSING

Thomas Carter '16, Ada Ng '16, Gina Buzzelli '16
Faculty Sponsor: Taikang Ning

This capstone project applies image processing techniques to quantify the severity of stenosis in bicuspid aortic heart valves. Stenosis occurs as the heart ages, when calcium deposits and scarring builds up on the aortic cusps, the valve narrows, and in turn blood flow is restricted. This type of heart disease is very common in older individuals and is identified through interpreting echocardiogram images.

The challenge of our capstone project is to assist doctors in identifying and quantifying the severity of stenosis in bicuspid aortic valves so they can offer preventative care. This medical problem is translated to an engineering design project with the use of MATLAB software. Through image enhancement techniques, an echocardiogram image of a bicuspid valve is made more readable. We take advantage of the contrast between the cusps and the blood vessel to perform image segmentation. Following this, the valve region is automatically detected by our program. Subsequently, the area is calculated and compared to known values of healthy aortic valves. The result of our program closely resembles the accuracy obtained from manual measurement. This project successfully provides an alternative diagnostic tool for the quantification of stenosis.

41.

COMPUTATIONAL STUDIES OF METHANE IGNITION/COMBUSTION AND SHOCK TUBE GAS DYNAMICS

Colbie Cook ‘19, Lucas Duros ‘19, Jack McInnis ‘19
Faculty Sponsor: John D. Mertens

Computational Study of Methane Ignition/Combustion

Ignition is a process that occurs when a hydrocarbon fuel reacts with oxygen gas to form water and carbon dioxide. When ignition occurs, electromagnetic potential energy is converted into kinetic energy and E&M radiation, raising temperature rapidly on a scale of microseconds. Whether a combination of fuel and oxygen ignites is dependent on the initial temperature and pressure of the gases. In an effort to find which combinations of gases and initial conditions yield ignition for methane (CH4), the program Chemkin was used in combination with a 120 chemical reaction model. For a fixed ratio of concentrations of methane and air (assuming only O_2 and N_2), the ignition temperature was determined at pressures ranging from 0.1 to 100 atmospheres. Using Chemkin, a reaction flow chart was also developed, identifying the important reaction pathways that converted the carbon and hydrogen to CO_2 and H_2O. Using the information obtained for fixed ratios of fuel to air, ignition graphs were created detailing the specific combinations of temperature and pressure that yield ignition.

Computational Study of Shock Tube Gas Dynamics

Gas dynamics is the study of the properties of gases and their thermal effects. Shock tubes are instruments that nearly instantaneously heat up gas using supersonic shock waves to study combustion reactions at a specific high temperature. An Excel file was created and programmed to calculate the gas dynamic conditions inside a shock tube from initial states. Values for initial temperature, initial pressure, and speed of the incident shock wave were added to the cells and automated calculations were performed to determine final temperatures, pressures, and densities behind the incident and reflected shock waves.

42.

SMALL SCALE, OFF-GRID WATER SANITIZATION SYSTEM

Brenin Ford ‘17, Michael Munzer ‘17, Brigand Blake ‘16, Connor Kennedy ‘16
Faculty Sponsor: Prabhakar Venkateswaran

A solar powered, off-grid system was developed to combat potable water shortages in developing nations without reliable power utilities. Using a combination of high voltage pulsed

power treatment and foam fractionation, this system successfully deactivated and removed coliform bacteria from samples of water taken from the Connecticut River. Pulsed high voltage discharge deactivated bacteria via pulsed electric fields, creation of powerful oxidizers and UV emission. Foam fractionation skimmed off small flocculated contaminates using the surface tension of water entrained with bubbles. Under constraints of off-grid power, the system is efficient requiring approximately 120 watthours per run cycle to process 5 gallons of water. After a treatment time of 50 minutes, a 98% reduction in coliform bacteria was observed in test samples.

43.
EYE GAZE TRACKING
Khari Jarrett ‘16, Giselle Garcia ‘16, Mauricio Uyaguari ‘16
Faculty Sponsor: Taikang Ning

This project aims to assist those with limited mobility of their hands by providing a hands-free alternative to using the computer. We plan to achieve this by developing a non-intrusive human-machine interface by means of gaze-tracking whereby we will determine where the user is looking and display the results. We will use strategically placed infrared light emitting diodes to produce corneal glints from the user’s eyes. Image processing technology will be utilized to map the location of the glints with respect to a chosen physical landmark of the human eye (eg. the pupil) onto the corresponding point of gaze on the monitor. The components of this project include: the design of the video vision subsystem to capture images of the user’s eye, the image processing algorithm to detect the glint and determine its location, the correlation matrix transformation algorithm, development of a user friendly GUI for calibration, operation and verification as well as experimental tests for performance analysis.

44.
HIGH FIDELITY (HI-FI) BOOMBOX
Mande Magassouba ‘16
Faculty Sponsor: Joseph Palladino

This class consisted of designing an engineering product within a two semester joint design class for B.S. Engineering majors. In the first semester, a capstone design project (The BoomShock) was started and finished with the objective of producing a high impact resistant loudspeaker system, that design prototype was completed with a group of 3 other students, Travis Kotecco, Mioatian Yang, and Iver Hulleberg. In the second semester of the class, a new engineering design project was begun by my project advisor and I. The objective of this project, was to design the prototype to a high fidelity boombox given a budget of $125.00. The specifications determined beforehand were: a two-way speaker system (two woofers and two tweeters), two 2^{nd} order passive crossovers, and the Tripath 2024A class-d amplifier. The prototype was determined not to be fully built by semester’s end, due to loss of group members and the lack of adequate funding to include all the original desired features given a similar time frame to work on the project. Most of the semester was spent learning and researching audio engineering theory, part selection, passive crossover design and analysis. The Butterworth crossover and Linkwitz-Riley crossover designs were compared and analyzed. Each crossover schematic was created with B2Spice program, and small signal analysis provided a bode plot of each crossovers’ respective frequency response. The bode plot confirmed that our cutoff frequency (*fc) twice* the resonant

frequency, of 4250 Hz was achieved. The frequency response was as predicted for all the designs (with a error of +-3% innate inductor property). The complete electronic audio system was built to be tested in the last week of the design class, but the amplifier was damaged during the process pushing the timetable back to produce a fully functional boombox prototype. The results confirm that the passive crossover designs function in the correct fashion as it should in terms of engineering theory.

45.
IGVC
Jacob Mevorach ‘16, Mike Castellana ‘16, Romero Board ‘16, Robin Chen ‘16, Hang Yang ‘16, Barok Imana ‘16, Jin Pyo Jeon ‘19, Thai Le Duy ‘16, Baslieal Imana ‘17
Faculty Sponsor: John D. Mertens

The Intelligent Ground Vehicle Competition (I.G.V.C.) takes place each June in Michigan where teams from across the world compete. These robots must navigate autonomously through a course while avoiding obstacles and staying within a traveling lane demarcated by two parallel white painted lines. Robots must maintain an average speed less than 5 M.P.H. throughout the course of the competition and can be no more than 7’ x 4’ x 6’ and no less than 3’ x 2’ x 0’. Trinity has competed in the I.G.V.C. for over a decade now and this year the robotics team has constructed a new robot from scratch named E.A.R.L.. EARL is an autonomous vehicle built using Robot Operating System (R.O.S.) as a computing platform. It uses NVIDIA Tegra™ peripheral boards to processes images from a pair of cameras. Contained within E.A.R.L. is a cooling system, control panel for motors and overall power supply and onboard odometry systems designed to calculate position, heading and speed. It has a LIDAR unit. The frame of the chassis is built using aluminum extrusions and locomotion is achieved through a pair of hub-motor wheels.

46.
RECIRCULATION ZONE ANALYSIS
Tristan Peirce ‘17
Faculty Sponsor: Prabhakar Venkateswaran

Many practical combustion configurations, such as gas turbine burners, consist of multiple interacting flames, and as a result, are an active area of research. In this work, a large set of high-speed particle image velocimetry (PIV) data was collected at the Pennsylvania State University for two representative bluff-body geometries at varying Reynolds numbers for reacting and non-reacting flows. A key feature of bluff-body flows is the presence of a recirculation zone behind the bluff-body that plays a crucial role in flame stabilization. To better understand this region, these data were then analyzed to extract quantitative information on the recirculation zone dynamics. In particular, we focus on the effects of adjacent flow fields and flow velocity on the size and topology of the recirculation zone. Finally, some preliminary flame edge detection results from the PIV data are also presented.

47.

AUTONOMOUS DECISION MAKING ROBOARM

Salvatore Siciliano ‘16, Madeleine Boudreau ‘16, Thai Le ‘16, Patrick Hoagland ‘16
Faculty Sponsor: Joseph Palladino

The goal of the RoboArm Senior Project was to autonomously complete a “Trinity T” shaped puzzle. The project combined mechanical and electrical components with decision making logic, which analyzed the colors present in a video feedback of the robot’s environment. The robot uses LabVIEW graphical programming by National Instruments along with a Logitech webcam to capture an image of a block to determine its color, then again to determine the presence of a block in a given position on the puzzle. The mechanical components were designed to allow the robot to access all 45 positions on the puzzle using five degrees of freedom. These degrees of freedom were controlled by four servo motors and one stepper motor using pulse-width modulation signals and DC power sources. Although the RoboArm can successfully complete the puzzle, using hard-coded positions decreased the accuracy of each placement. This could be improved by adding encoders. Overall, the project demonstrates how incorporating decision making based on feedback signals can improve quality and safety in industrial robotic production.

48.

REAL TIME FIRST AND SECOND HEART SOUND DETECTION WITH EMBEDDED SYSTEM

Dana Wensberg ‘18, Deven Roberts ‘18
Faculty Sponsor: Taikang Ning

This paper describes the implementation of a robust digital stethoscope capable of real time first and second heart sound (S_1 and S_2) detection and heart sound display. The heart sound detection algorithm employs a layered local peak timing and dynamic thresholding approach. The device collects an incoming heart sound waveform and analyzes its shape. The presence of a peak is first determined by the behavior of surrounding points, and then this peak is compared to timing constraints and a dynamic threshold value to discern if the peak is an S_1 or S_2 moment. The system was tested against the Bioscience heart sound database and evaluated on its sensitivity and specificity of S_1/S_2 detection. The algorithm showed accurate detection when exposed to a wide array of heart sounds, representative of 14 different heart conditions of varying severity that exhibit 21 different kinds of heart sound abnormalities.

ENVIRONMENTAL SCIENCE

49.

THE EFFECTS OF CLEAR-CUTTING ON SOIL ALUMINUM AND CALCIUM LEVELS IN THE WHITE MOUNTAIN NATIONAL FOREST, NEW HAMPSHIRE AND MAINE

Jack Agosta ‘17, Elias Peterson ‘19, Lauren Tierney ‘16
Faculty Sponsors: Jonathan Gourley, Andy Coulter (U.S. Forestry Service)

While clear-cutting is a widely-used and highly profitable method of harvesting timber, it has been shown to have serious negative effects on the surrounding forest ecosystem. One of these

effects is the significant alteration of soil nutrient concentrations due to soil nutrient leaching and runoff. This study focuses on changes in soil aluminum and calcium levels. Aluminum is a key nutrient for plant growth and calcium is important for root, leaf and flower stability and health. Working with the USDA Forest Service, soil samples were taken on transect lines at three different clear-cut study sites in the White Mountain National Forest of New Hampshire. Samples were taken from the O and B-horizon at two sites: Hogsback just east of the Vermont/New Hampshire border, and Millstone in western Maine. The samples were processed using acid digestion before being run through the Inductively Coupled Plasma-Optic Emission Spectrometer (ICP-OES) where aluminum and calcium concentrations were measured.

The sites were sampled both prior to clear-cutting in order to measure baseline nutrient concentrations in 2013 and again, one-year and two-years post clear-cut to measure the changes in aluminum and calcium and calcium within each horizon. GIS was used to create maps to show the nutrient concentration changes throughout the clear-cut sites from year to year in each soil horizon.

50.

ANALYSIS OF THE EFFECTS OF CLEAR-CUTTING ON MERCURY CONCENTRATIONS AND ORGANIC MATTER IN SOIL ON THE WHITE MOUNTAINS

Cassia Armstrong ‘18, Steve Leo ‘17, David Johnston ‘16
Faculty Sponsor: Jonathan Gourley

In past studies, a positive relationship has been found between the percentage of organic materials in soil and concentrations of mercury. Studies have also shown that less densely forested areas are correlated to increases in mercury concentrations. In clear cutting, these observations seem to contrast each other, as forest loss means more exposure to airborne fallout, but also decreases in organic content. In 2014, two sites in the White Mountains were clear-cut. The two sites of focus for this presentation are "Hogsback" (New Hampshire) and "Millstone" (Maine). Soil samples were gathered from these locations prior to the clear cutting in 2013, and samples have been gathered annually since the clear-cuts. Samples were freeze dried, and mercury concentrations were determined using a Milestone Direct Mercury Analyzer (DMA). Thus far, data shows significant decreases in mercury concentrations between 2013 and 2014 for Millstone and Hogsback. For the Hogsback site, organic matter significantly decreased as well, however for Millstone the percent organic matter remained relatively the same showing only a slight decrease after being clear-cut. Between 2014 and 2015, the concentration of mercury showed a significant increase for Millstone. The data for 2014 and 2015 of Hogsback is currently being compiled. This study is a comparison of results overtime, so it is to be determined whether this trend will continue in future site samplings. Another focus of this semester was determining a method for methylmercury extraction so as to provide further insight into the binding characteristics of mercury to soil and its environmental effects. The final results of this study will be shared with the USDA Forest Service to further understanding on how current clear-cutting methods affect soils.

51.

THE RELATIONSHIP BETWEEN MERCURY CONCENTRATIONS AND ORGANIC CARBON PERCENTAGES IN THE PARK RIVER

Camden Howe ‘16
Faculty Sponsor: Jonathan Gourley

Previous research has been divided about the relationship between organic carbon percentages and Mercury concentrations in river sediments. The results range from no correlation to a weak positive correlation, where increased anthropogenic alterations may hide the underlying relationship. I compiled data that observed river sediments in the Park River from myself, Dan Pidgeon (‘16), and Kate Pool (‘12). When all of the data was combined there was initially no correlation. Further analysis showed a slight positive correlation for all samples in the north branch as well as samples from Kate Poole in both the north and south branches. Kate Pool’s data had statistically lower organic carbon percentages on the one percent level than Dan’s and my data, while the Mercury concentrations were similar for all three researchers. When all of the individual researcher’s data was transposed onto a single chart the slight positive correlation failed to turn into an overarching positive correlation. Instead the data varied widely, and no discernable correlation could be obtained. This may be due to human alterations since the south branch is more industrialized than the north branch, which skews the data due to increased pollutant runoff from impervious surfaces.

52.

THE EFFECTS OF PRESCRIBED FIRES ON SOIL MAGNETIC PROPERTIES

Shane McLaughlin ‘19, Nicole Towner ‘19
Faculty Sponsor: Christoph Geiss

Studies have shown that forest fires cause magnetic enhancement in soils. Extremely high temperatures can reduce iron-bearing minerals in surface soils, leading to increased magnetism of the soil, as well as higher charcoal density. In order to reconstruct the frequency of past fires, a 2.4 meter deep soil profile from the Hitchcock Nature Center in southwest Iowa was analyzed. For each depth, magnetic susceptibility, frequency dependent susceptibility, anhysteretic remanent magnetization(ARM), and isothermal remanent magnetization(IRM) were measured. For the selected depths charcoal density was measured as well. It was found that magnetic properties vary little through the soil profile, and none of the samples are strongly magnetic. The charcoal analysis is ongoing, and so far, the samples have very low charcoal densities, except the sample from 30-35cm. This sample does not differ significantly in its magnetic properties, so the high charcoal density is likely an anomaly. Overall, the low concentration of magnetism minerals and low charcoal densities of the samples seem to indicate that the site was influenced little by fire, despite a history of natural and prescribed burns in the area.

HEALTH FELLOWS

53.

A RETROSPECTIVE STUDY ON THE EFFECTS THE KETOGENIC DIET HAS ON BEHAVIOR AND TEMPERAMENT IN CHILDREN WITH EPILEPSY

Ariana Adamski ‘17
Faculty Sponsors: Susan Masino, Sarah Raskin, Maryann McGuire R.N., M.P.H., Francis DiMario, M.D., Beth Chatfield, R.D., Jamie Cubanski, R.N., Connecticut Children’s Medical Center

In this study, the interaction between the ketogenic diet (KD) and behavior in children with epilepsy treated at Connecticut Children’s Medical Center (CCMC) was researched. Since 1921, the KD has been used as an effective treatment option for patients with intractable epilepsy. The diet consists of a high fat to low carbohydrate and moderate protein ratio, most popularly administered at 4:1 (76% fat) or 3:1 (66% fat). Parents of children eligible for this study were surveyed using a questionnaire designed by the researchers as well as the appropriate Carey Temperament Scale (according to the age of the patient in question). The findings of this study—a comparison of two patients on the KD—are consistent with current scientific literature in that our two patients have had some behavioral improvements since the onset of the KD, as reported by a parent/guardian. Future studies will explore the “on KD” and “off KD” patient comparisons with more extensive survey materials exploring various avenues of behavior and temperament.

54.

ESTABLISHING A REFERENCE DATABASE FOR COLLEGIATE ATHLETES USING THE ELITE BALANCE PROTOCOL

Zachary Bitan ‘17
Faculty Sponsors: Sarah Raskin, Maryann McGuire R.N., M.P.H., Matthew Solomito Ph.D., Connecticut Children's Medical Center

Recent studies have shown that static balance alone is not enough to appropriately assess post-concussion balance and recovery; this is because these tools are unable to identify the affected systems of a concussion. Therefore, it has been proposed that a dual task (cognitive load and balance) is used as most athletes are required to perform both a physical and mental task to be successful at their sport. Dual tasks require the patient to split his/her attention between balance and a cognitive load. Thus, testing patients in a dual task condition is more applicable to a real world setting. This study was a prospective, non-randomized study that sought to validate the use of the Elite Balance Protocol (EBP) as a tool to assess post-concussion by establishing an EBP reference data set for non-concussed collegiate athletes. The data was collected using a Nintendo Wii balance board and Matlab. The results indicated an overall trend for decreased sway area when subjects performed the dual task balance compared to single task balance conditions. The results of this study are consistent with other studies that have noted an improvement in balance when a dual task was administered. Therefore, using the collected reference data it is possible to compare EBP data collected from concussed athletes to the reference data collected in this study; thus allowing for a clinical tool to assess and track the recovery of a concussion.

55.

IMPROVING EARLY DETECTION OF AMBLYOPIA IN YOUNG CHILDREN AT THE PRIMARY CARE CENTER AT CONNECTICUT CHILDREN'S MEDICAL CENTER

Martha Griffin '16
Faculty Sponsors: Sarah Raskin, Maryann McGuire R.N., M.P.H., Catherine Wiley, M.D., Patricia Garcia, M.D., Connecticut Children's Medical Center, Whitney Washburn (University of Connecticut School of Medicine '18)

In the context of a broader project aimed at improving vision screening for preschoolers, the Primary Care Center at Connecticut Children's Medical Center is interested in minimizing the frequency of missed referrals to eye care specialists for three year old well-child patients, with the long-term goal of improving the early detection of amblyopia. In order to do so, we first characterized the current use of autorefraction and the referral processes in place, designed and implemented a series of improvement strategies, and lastly compared the newly optimized referral practices with previous findings. The interventions of referral education, individual accountability, and visual cue cards were not associated with an immediate increase in referrals made. Moreover, the goal referral rate of 90% was not met during the first month post-intervention, but will remain a goal for the Primary Care Center.

56.

TECHNICAL MISADVENTURES DURING PATENT DUCTUS ARTERIOSUS LIGATION: LIGATE WITH CARE

Julianna Maisano '17
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Patent ductus arteriosus (PDA) ligation is one of the most common cardiovascular procedures performed on neonates in the United States. Currently there are no studies that characterize major technical mishaps that occur during this operation. The purpose of this study is to describe potentially catastrophic complications that occur during neonatal PDA ligations. We interviewed a convenience sample of ten pediatric subspecialists with firsthand knowledge of major intraoperative complications that occurred during neonatal PDA ligation cases from 1998 through 2013. Major complications were defined as hemorrhage greater than one blood volume and ligation of structure other than the PDA. Data collected for each case included year case was performed, type of complication, surgical approach, surgeon subspecialty training, hospital type, need for reoperation, and mortality. We identified sixteen cases with major intraoperative technical mishaps from eleven hospitals in eight states. Complications reported included 6 (38%) left pulmonary artery ligations, 4 (25%) major intraoperative hemorrhage, 3 (19%) bronchus ligations, 2 (13%) aorta ligations, and 1 (6%) hemiazygous vein ligation. Nine (60%) cases required reoperation and three patients died as a direct result of the surgical error. Subspecialty of the surgeon performing the initial procedure: pediatric general surgeons (n =9, 56%), adult cardiothoracic surgeons (n = 4, 25%), and pediatric cardiothoracic surgeons (n =3, 19%). Mean years since completion of fellowship training for the attending surgeon was 15 ± 10 years. Four (25%) cases involved a trainee. Potentially catastrophic technical mishaps can and do happen to experienced surgeons who perform PDA ligations. Surgeons who perform this operation should have an actionable plan to deal with major intraoperative hemorrhage and always clearly identify juxtaductal anatomy before proceeding with ductal closure.

57.

EFFECT OF HYDROXYUREA THERAPY ON OXYGEN SATURATIONS OF PEDIATRIC PATIENTS WITH SICKLE CELL DISEASE

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Faculty Sponsors: Sarah Raskin, Maryann McGuire R.N., M.P.H., Anita Bhandari M.D., Donna Boruchov M.D., Connecticut Children's Medical Center

Sickle cell disease (SCD) is an inherited genetic disorder that occurs when a copy of a mutant beta-globin gene is passed down from each parent. When the hemoglobin polymerizes, it produces a rigid, inflexible distortion of the red blood cell, altering the properties of the cell causing obstructions in the microvasculature. Hypoxemia, a condition in which there are low levels of oxygen in the blood, is a trigger for sickling of hemoglobin S cells and at low oxygen tensions there is increased polymerization of sickle hemoglobin. HU is an antineoplastic drug that treats SCD by reactivating fetal hemoglobin production, which in turn, increases the patient's blood flow. This study will be a retrospective chart review and the primary outcomes of this study will look at the differences in oxygen saturation and fetal hemoglobin on pediatric SCD patients over the course of one year. A paired t-test and ANOVA analysis will be done on the data of 30 CCMC patients that is collected. It was found that saturation increases with HbF ($p=.0025$) across all times, saturation increases with time ($p=.041$) independent of HbF, but the effect from HbF is more, and that time does not modulate the effect of HbF ($p=0.280$).The higher the HbF levels, the higher the O2 saturations levels. Saturation does increase with time, but that may only be due to the increase in HbF levels.

58.

CHANGING EPIDEMIOLOGY OF NEONATAL ABSTINENCE IN NEWBORNS AT HARTORD HOSPITAL

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Exposure to opiates in pregnancy places the newborn at risk for neonatal abstinence syndrome (NAS). NAS is a collection of symptoms caused by withdrawal from maternal opiates and/or other drugs to which the fetus had become dependent. The objective of the study is to determine the trend in prevalence and change in epidemiology of NAS in newborns admitted to Hartford Hospital from 2006 to 2015. Variables that influence an infant's length of stay were also investigated. Demographic data was collected identified subjects using International Classification of Disease (9^{th} and 10^{th} revision) discharge codes relating to NAS and opiate use during pregnancy. Substance exposure data was collected using the electronic medical record. The annual number of NAS cases fluctuate from 2006 to 2015, but are generally increasing. Infants with NAS were born predominantly to Caucasian women. In relation to population, Barkhamstead, East Granby, and Stafford are all small towns in rural areas with high prevalence of NAS. Breastfeeding an infant decreases the likelihood for pharmacologic treatment and transfer ($x^2 = 4.61$, $df = 1$, $p < 0.05$). Polysubstance exposure adversely affects an infant's by extending its length of stay ($x^2 = 20.2$, $df = 1$, $p < 0.05$). 61.5% of mothers had a mental health disorder which is a significantly higher than national rates of psychiatric disorders in pregnant women ($P<0.05$). The growing opioid epidemic creates higher prevalence in childbearing women. As a result, more infants are born with NAS and have a difficult first few months of life. Outcomes for infants with NAS may be bettered by improved screening and access to treatment

for substance abuse and mental health disorders, and by encouraging mothers using opiates to breastfeed.

59.

DETERMINING THE OPTIMAL UV RADIATION DOSE AND P38SJ PROTEIN DOSE TO KILL OFF THE U-87MG GLIOBLASTOMA CELL LINE

Jasmin Williams ‘17
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Glioblastoma multiforme (GBM) are the most common type of primary brain tumors, with an incidence of 2 per 100,000 adults per year in the U.S. Malignant gliomas are a highly aggressive type of tumor with extremely poor prognosis. These tumors are highly invasive and are often surgically incurable and resistant to chemotherapeutics and radiotherapy. Although, there are many drugs and treatments that have been developed to treat GBM, most are not clinically efficacious. Previous studies reveal that the p38SJ, a novel member of the DING family of proteins, derived from *Hypericum perforatum* calluses, has an effect on the growth of malignant glioma cell lines U-87MG. Additionally, exposure to ultraviolet radiation has been shown to kill off U-87MG glioblastoma cell line but not all glioblastoma cells. In this study, we determined the optimal dose for the combination treatment of UV radiation and p38SJ protein to kill off the U-87MG glioblastoma cell line. The U-87MG cells were exposed to various doses of UV radiation and p38SJ protein for 10 days and a cell colony formation was analyzed by *Image J* software. Our results demonstrate that the combination treatment of 10 µg/ml of p38SJ protein and 3 mJ/cm^2 of UV radiation provided the most effective cell death for the U-87MG glioblastoma cell line. These findings suggest that the synergistic relationship of p38SJ protein and UV radiation may be a promising therapeutic in the treatment of malignant gliomas.

MATHEMATICS

60.

THE SECRET OF NIM

Adam Fong ‘17, Dylan Spagnuolo ‘17, Jack Wallace ‘17, Shufan Wang ‘18
Faculty Sponsors: John Georges, David Mauro, Kirsti Wash

Nim is a classical two-player game in which players take turns removing items from piles until every pile has been completely emptied. Though there exist many variants of the game, we will consider traditional Nim, in which each player must remove at least one item from a single pile during their turn, and the winner is the player who removes the last remaining item from the last remaining pile. In traditional Nim, with optimal play, the winner is determined entirely by the initial distribution of items in the piles. This is done by categorizing the distribution into different states through the use of binary arithmetic. A recent variation of the traditional game, Nim with a pass, adds a single pass to the game, which may be used by either player but not by both in the same game. The added complexity of the pass makes determination of the winner more difficult. In our project, we research Nim with a pass and determine the winner for some classes of games. We will present our results on Nim with a pass as well as the methods of proof used for obtaining these results. In addition to learning about Nim, attendees will be able to play each other and us in games of Traditional Nim and Nim with a pass.

NEUROSCIENCE

61.

USING NEUROBIOLOGY TO DIAGNOSE PSYCHOSIS: COMPARING DIFFUSION TENSOR IMAGING DERIVED WHITE MATTER CONNECTIVITY IN DSM DIAGNOSES VS. IN BIOLOGICAL PSYCHOSIS SUBTYPES

Geoffrey A. Bocobo '16
Faculty Sponsors: Sarah Raskin, Maryann McGuire R.N., M.P.H., Godfrey Pearlson, M.D., Shashwath Meda M.S., Institute of Living

Objective

For decades, clinicians in psychiatry have primarily relied on symptom-based diagnoses. Though, psychoses present an intriguing scenario wherein there exists significant overlap between allegedly distinct disorders, in terms of risk genes, symptoms and treatment response; this creates a situation where differential diagnosis becomes difficult to ascertain. Unfortunately, clinical phenomenology has largely overshadowed an important aspect of diagnosing mental disorders: neurobiology. However, with vast improvements in brain imaging technology, there has been a push for the utilization of more objective based measures. To this end, the present study utilized objective brain based markers to re-categorize psychoses patients and transcend conventional DSM boundaries. These novel groupings or "biotypes" were aimed to externally validate a popular imaging bio-marker of white matter connectivity called Diffusion Tensor Imaging. Furthermore, these categories were compared and contrasted against the gold standard DSM-based psychoses categories, to see which grouping is suggested to be superior.

Method

A large pool of neurobiological measures (e.g. eye tracking, auditory stimulation paradigms and electrophysiology) that characterize the many aspects and the diverse range of brain functions, was collected from healthy subjects (n=211) and the probands of psychosis (n=343), namely bipolar with psychotic episodes patients and schizophrenic patients. The patient were grouped into their original DSM groupings and into their new, respective biotype categories based on a previously published method (Clementz, 2016). Tract-Based-Spatial-Statistics (TBSS) analysis was used to "skeletonize" the DTI images and to run an ANCOVA; this analytical method determines the level of difference between each DSM group and each biotype group in two separate analyses. The resulting data would elucidate upon whether the DSM groups or the biotype groups hold more distinctions.

Findings

In the uncorrected permutation testing of the TBSS data, both bipolar and schizophrenia showed significantly lower FA values within many distinct brain regions ($p < 0.01$) as seen from the skeletonized DTI projected images. This validates the worth of neurobiology in the diagnosis of psychosis. The biotype groups are still being subjected to statistical analysis, and the DSM criteria is being corrected for multiple corrections, though regardless of the outcome, the study warrants replication with different diseases, population pools and criteria; it is exploratory and the first of its kind.

62.

IN UTERO ESTROGEN EXPOSURE & INCREASED RISK OF AUTISM SPECTRUM DISORDER (ASD): THE POTENTIAL EPIGENETIC LINKS BETWEEN MATERNAL HORMONE PROFILE, AND THE ELEVATED RISK OF GIVING BIRTH TO AN AUTISTIC CHILD

Geoffrey A. Bocobo '16
Faculty Sponsor: Molly Helt

A number of isolated studies have unearthed potential risk factors for autism, such as maternal obesity, close birth spacing, and conception while on birth control, consistent with the idea of a link between maternal endogenous estrogen exposure and autism risk. The current research seeks to explore whether these risk factors can be best conceptualized in terms of the hormonal milieu that the maternal environment provides by investigating these factors in the same cohort along with a number of other indicators of maternal hormone profile (specifically, the estrogen-progesterone balance). The biological mothers of autistic children (n=253) and the biological mothers of non-autistic children (n=221) were asked to complete an online survey designed to delineate maternal hormone profiles both before and during each pregnancy. The survey asked about previously established risk factors for autism, as well as those yet to be explored in mothers of autistic children that are expected to be influential, if differences in estrogen profiles is a general risk factor (e.g. breast cancer, hypothyroidism, early age at menarche etc.) The two groups showed significant statistical differences in their rate of breast cancer, rate of hyperthyroidism, Body Mass Index, and age at menarche, suggesting a possible connection between maternal estrogen levels and the pathogenesis of autism. This is the first study that we know of to hypothesize and explore such a link. The results from this study implicate maternal hormonal profiles as worthy of future study in relation to the etiology of Autism.

63.

THE EFFECTS OF INDIVIDUALIZED COGNITIVE REHABILITATION THERAPY FOR IMPROVING PROSPECTIVE MEMORY IN ACQUIRED BRAIN INJURY

Emily Aiken BA/MA '16
Faculty Sponsor: Sarah Raskin

Acquired brain injury (ABI) includes any damage to the brain that occurs after birth. Individuals with ABI report that prospective memory (PM) deficits are the most detrimental cognitive impairment following injury, impacting their ability to function in everyday life. PM refers to the ability to remember to carry out intended tasks in the future. Using neuropsychological assessments to produce patient profiles, this study examines the effectiveness of individualized cognitive rehabilitation therapies: attention process training (APT) or PM training, for improving PM in ABI. Case studies (n=9) of Kosakoff's syndrome, meningioma, traumatic brain injury (TBI), and stroke will be presented to illustrate the variety of cognitive deficits in individuals with ABI. Participants were randomly assigned to groups, completing 10 sessions of either active cognitive rehabilitation (n=5) or active control in the form of educational programming (n=4). Using the Memory for Intentions Screening Test (MIST) as the main outcome variable, intra and inter treatment analyses examined the effectiveness of individualized cognitive rehabilitation for improving PM in ABI (N=7).

64.

ELECTROPHYSIOLOGICAL CORRELATES OF TIME-BASED PROSPECTIVE MEMORY IN INDIVIDUALS ACROSS THE LIFESPAN

Erin E. Aisenberg ‘16, Christy C. Chan ‘18
Faculty Sponsor: Sarah Raskin

This study investigated the relationship between a clinical measure of time-based prospective memory (PM) and a computerized paradigm (Cona et al., 2012) that examined time-based PM in individuals in different age groups. PM involves the ability to form and realize intentions after a time delay (Einstein & McDaniel, 1990). The clinical measure of PM used was the Memory for Intentions Screening Test (MIST), which assessed both time- and event-related PM. These results will be compared with electrophysiological and behavioral data collected while participants completed a computer-based PM task that assessed time-based PM. It is expected that older adults, compared with younger adults, will be more accurate on PM trials, have reduced amplitudes over the frontal polar electrodes in response to PM cues, have more PM errors in both the MIST and computer-based task, and take longer to respond to PM cues. Additionally, it is expected that PM intention trials with increased frontal activation will correlate with MIST total score.

65.

CLINICAL AND PHYSIOLOGICAL MEASURES OF THE EFFICACY OF PROSPECTIVE MEMORY TREATMENT

Tessa Bloomquist ‘16, Chloe White ‘18
Faculty Sponsor: Sarah Raskin

Prospective memory (PM) involves the ability to form and realize intentions after a time delay (Einstein & McDaniel, 1990). This study examines the relationship between clinical measures of PM and an event-related potential paradigm (West & Ross-Munroe, 2002) before and after Cognitive Rehabilitation Therapy (CRT). Participants with traumatic brain injury (TBI) were assigned to one of two groups, CRT and an active control condition. Electrophysiological and behavioral data were collected while subjects performed a computerized PM measure and the Memory for Intentions Screening Test (MIST) (Raskin, Buckheit, & Sherrod, 2011), a clinical measure. The results from the two groups were compared to determine physiological and clinical change as a result of treatment.

66.

INDEPENDENT COMPONENT ANALYSIS (ICA) OF FMRI SCANS TO STUDY BRAIN ACTIVITY DURING EXPOSURE TO SPOKEN LANGUAGE

Naty Bush ‘19
Faculty Sponsor: Dan Lloyd

fMRI scans of one subject’s brain were produced by providing the patient with several different stimuli during the scanning. He was introduced to forward and backward music, speech, and videos. I determined how his brain reacted differently to forward and backward speech. MATLAB was the computer program used to upload the fMRI scans, and Group ICA Toolbox (GIFT) was used to observe the scans and determine which of the 30 components being analyzed were relevant. Independent component analysis (ICA) is a method of brain activity analysis

where the brain is divided into sections that activate in unison. This analysis allows for the determination of which parts of the brain are activated when the subject is introduced to specific stimuli. By using MATLAB and GIFT, I determined that brain activity was higher when introduced to forward speech rather than to backward speech. The difference in brain activity between the averaged forward and backward speech had a z-score of 0.5966, as an average of all 30 components. The areas of the brain that indicated the greatest contrast between forward and backward speech were the uncus, inferior frontal gyrus, medial frontal gyrus, cingulate gyrus, precuneus, and posterior cingulate.

This information concludes that the brain is more active when being introduced to stimuli that it can understand rather than stimuli that it cannot understand. Forward speech was also shown to activate parts of the brain associated with regulating emotions and comprehending auditory speech. With this information, it may be possible to better understand how easily individuals are able to learn a new language, as foreign language is often as difficult to understand as backward speech.

67.

COMPARED WITH WARFARIN, DIRECT ORAL ANTICOAGULANTS ARE ASSOCIATED WITH IMPROVED PATIENTS OUTCOMES IN BLUNT TRAUMATIC ICH

Monica DiFiori ‘16, Lilla Kis ‘18
Faculty Sponsors: Sarah Raskin, James Feeney

Falls represent the leading cause of traumatic brain injury in adults older than 65, with nearly one third experiencing a fall each year. Direct oral anticoagulants (DOACs) have become increasingly popular, however, there is a dearth of research regarding the safety of DOACs, in particular on the outcome of traumatic intracranial hemorrhage (ICH). We queried our Trauma Quality Improvement Project (TQIP) registry for patients who sustained traumatic ICH during anticoagulant use. Patients were then stratified based on prescription of warfarin or DOAC medications. The two groups were compared with respect to age, gender, Glasgow Coma Score (GCS) on arrival, Injury Severity Score (ISS), Abbreviated Injury Score (head) (AIS (head)), mechanism of injury (MOI), injury characteristics (location and number of lesions), mortality, need for operative intervention, hospital and intensive care unit length of stay (HLOS and ICU LOS, respectively), proportion of patients transfused (and their transfusion requirements), and discharge to skilled nursing facility (SNF). DOAC use was associated with significantly lower mortality, lower rate of operative intervention, and decreased rate of discharge to SNF when compared to warfarin in traumatic ICH patients.

68.

EPILEPSY AND THE KETOGENIC DIET: A METABOLOMIC ANALYSIS

Julia Duggan ‘16
Faculty Sponsors: Susan A. Masino, David N. Ruskin

Clinical evidence demonstrates that the ketogenic diet (KD) is a highly effective therapy for epilepsy. Children can achieve and maintain seizure freedom even after removing antiseizure drugs and ending the KD. However, it is still impossible to predict when the KD therapy will be successful, and its mechanism remains unknown. We are assaying cerebrospinal fluid (CSF)

obtained by a team based at Karolinska Hospital in Stockholm, Sweden. CSF was collected from 25 children with refractory epilepsy before and at three months of maintenance on KD therapy. Anticonvulsant outcomes were varied. Preliminary metabolomics analysis of the data from children was limited to lipids and their metabolites, as high dietary fat is a necessary component of KDs. Forty-eight lipid-related compounds were detected. Of these 48, KD treatment caused significant changes in 18, mostly increases. KD treatment was found to change more metabolites in seizure responders than non-responders; non-responders did not have significant changes in ketone bodies, a biological hallmark of successful KD treatment. In parallel, metabolomic profiling of CSF obtained from rats fed control and KD to compare changes in children to those in an animal model. Thus far, the rat study has supported the efficacy of the KD in raising blood ketone levels, decreasing blood glucose levels and the rate of weight gain in rats. We hypothesize that these two studies together will 1) determine how the metabolic stamp of various pathways as well as individual metabolites change due to KD therapy; 2) determine which changes correlate with KD efficacy in children; 3) determine which baseline characteristics predict efficacy in children; 4) enable a detailed comparison between diet- mediated changes in human and rodent CSF fluid. Predicting efficacy could help identify and motivate patients who could achieve the greatest benefits. Furthermore this work could yield targets to pursue regarding key metabolic changes mobilized by a KD.

69.

THE EFFECTS OF INDIVIDUALIZED COGNITIVE REHABILITATION FOR PROSPECTIVE MEMORY (PM) FOR ADULTS WITH MILD COGNITIVE IMPAIRMENT (MCI)

Thomas J. Hum-Hyder ‘17
Faculty Sponsor: Sarah Raskin

Prospective memory deficits are the earliest markers of cognitive decline in MCI individuals. Prospective memory can be thought of as the ability to remember to perform an intention. Mild Cognitive Impairment (MCI) is clinically diagnosed when an individual has an intermediate level of cognitive decline that is greater than expected given one’s education and age. Using attention processing training, prospective memory training, and Virtual Week, we looked at the potential for attenuation of prospective memory deficits for mild cognitive impairment individuals. MCI is believed to predict a trajectory towards a later diagnosis of Alzheimer’s Disease (AD), which is corroborated by autopsied MCI patients who had neurofibrillary pathology in the entorhinal cortex, hippocampus, and amygdala. Further, recent meta-analysis has suggested that a quarter of MCI individuals can progress from MCI decline to normal decline.

70.

THE EFFECTS TWO DIFFERENT KETOGENIC DIETS, VARYING IN NUTRIENT CONSTITUTION, ON THEIR ABILITY TO ALLEVIATE AUTISTIC SYMPTOMS IN A MOUSE MODEL

Carter Jones ‘19, Alex Suarez ‘16
Faculty Sponsors: David N. Ruskin, Susan A. Masino

Autism is a neurological developmental disorder characterized by communication and social deficits and repetitive behaviors. The ketogenic diet (KD) is a high fat, restricted carbohydrate therapy. A strict version of the KD has recently been found to reverse autistic symptoms in the

BTBR mouse model of autism. Here we aim to examine two milder, more clinically relevant KD in the BTBR model. To measure the effects of these KDs on symptoms of autism, the three-chambered sociability test was conducted and blood was drawn at baseline and three weeks after diet initiation. Neither of the milder diets alleviated the symptoms of autism and blood glucose levels were also elevated. We suspect that the high levels of blood glucose might have interfered with the ability of the KD to exert its effects. Further study will need to be done in order to elucidate the exact mechanism through which the KD operates.

71.

FEELING AND SPEAKING: THE ROLE OF SENSORY FEEDBACK IN SPEECH

Francesca Marino ‘16
Faculty Sponsor: Elizabeth Casserly

Studies indicate that talkers are able to use sensory feedback to accurately control speech production. Auditory information is the predominant form of speech feedback; however, talkers have been shown to rely more heavily on somatosensory feedback when auditory information is degraded. Furthermore, during audio-visual integration studies, results showed that participants displayed greater speech perception abilities when both auditory and visual information were available. In this study, we experimentally degraded auditory feedback using a cochlear implant simulation and somatosensory feedback using a topical over-the-counter numbing gel. Additionally, we placed a mirror in front of the talkers to create an environment in which visual information was the most reliable form of sensory feedback. Speech recordings were collected as participants were prompted to speak under the baseline, feedback degraded, and visual condition. These recordings were then used in a playback study to determine the intelligibility of speech. This tested whether people were able to successfully alter their speech behavior to make use of maximally available sensory information. In the auditory discrimination task, listeners selected speech from the baseline condition as easier to understand significantly more often than speech from either the feedback degraded or visual condition. In the visual discrimination task, listeners selected speech from the visual condition as easier to understand significantly less often than speech from the feedback degraded condition. Listener preference of baseline speech was significantly greater when both auditory and somatosensory feedback were degraded then when only auditory feedback was degraded (Casserly, in prep., 2015). These results suggest that feedback was successfully degraded and that the addition of visual feedback decreased speech intelligibility.

72.

AN IN VIVO STUDY OF THE EFFECTS OF PERINATAL CAFFEINE EXPOSTION ON SYNAPTIC EFFICACY IN THE HIPPOCAMPUS OF ADULT, FREELY MOVING RODENTS

Jee Eun Park ‘16, Thomas Gitchell ‘18, Vy Phan ‘18, Alex Bednarek ‘18
Faculty Sponsor: J. Harry Blaise

The Electrophysiology laboratory at Trinity College currently uses the synapse from the perforant path to the dentate gyrus as the cellular model for learning and memory, specifically long term potentiation (LTP). Caffeine is one of the most widely consumed psychoactive stimulants in the world. Its effects in neurological functions, such as increase in alertness and

improvements in motor skills, have promoted its use throughout history. Although the many beneficial short term effects of caffeine intake are well understood, the long term effects of caffeine exposure have been widely disputed. Despite this, over over 80% of women continue to consume caffeine throughout pregnancy. The objective of this experiment was to determine the effects of perinatal caffeine exposure on LTP in adult, freely behaving male rats. Caffeine water (1.0g/L) was administered to the mother during gestation and until 21 days after the birth of the pups. Once the male pups reached 70-120 days, stereotaxic surgery was performed to implant electrodes into the dentate gyrus and perforant path. After a week of recovery, the population spike amplitude was measured before and after high frequency stimulation to determine LTP levels. It was observed that early caffeine exposed pups showed lower body weight at 21 days. Also, given a sample size of N=11, LTP level was significantly lower for the early caffeine exposed rats (p value <0.01). These results may be representative of the upregulation of adenosine 1 receptors. In addition, the caffeine's disturbance in fetal development during gestation and the critical period may have long term consequences in proper neuronal activity of the individuals. Future studies may include spatial memory behavioral tests to either confirm or deny these results of the experiment.

73.

SHORTENED MEMORY FOR INTENTION SCREENING TEST

Meaghan Race '18, Erin Aisenberg '16
Faculty Sponsor: Sarah Raskin

The Memory for Intention Screening Test (MIST) is a measure of prospective memory. Prospective memory (PM) is the ability to form and recognize intentions after delay period (Einstein & McDaniel, 1990). The MIST was designed to be a brief standardized clinical measure of PM in clinical populations using event-based and time-based cues (Raskin, 2009). However, in clinical practice, the MIST can be cumbersome as it requires approximately 30 minutes. This study was conducted to modify the original MIST for ease of administration in a standard battery. Using tasks from the original test the MIST was revised to allow for the use of other standard clinical measures as the ongoing task. In addition, a series of prospective memory tasks and retrospective recognition recall questions were removed. The administration time was cut from 35 minutes to 18 minutes. After pilot studies using a variety of tests as the ongoing task (Boston Naming Test, Wisconsin Card Sorting Test, WAS-IV) these measures were all found to be problematic due to the need to interrupt the delay period of the MIST to give instructions. In the current study, background information questionnaires were used instead and this appears to be both sufficiently attention demanding but also does not require interruption by the experimenter. Data are presented to support the psychometric properties of the shortened measure.

74.

KETOGENIC DIET FOR SEIZURE CONTROL IN DOGS

Hannah R. Reichert '18
Faculty Sponsors: Susan A. Masino, David N. Ruskin

Epilepsy is one of the most common neurological disorders in humans and canines. For at least 30% of those diagnosed with epilepsy current drugs are ineffective; some seizures do not respond to these medications and/or cause serious side effects. Patients and caregivers, including

dog owners, must consider other treatments. One option is the high-fat, low-carbohydrate, and adequate-protein ketogenic diet. This metabolic therapy forces the body to use ketones for fuel rather than glucose. The ketogenic diet has been used since 1921 to treat epilepsy and it can stop seizures when drugs are ineffective. This case study details the benefits of a homemade ketogenic diet prepared for a dog suffering uncontrolled epileptic seizures. The dog experienced fewer seizures eating a ketogenic diet than when administered antiepileptic drugs – at some points experiencing a complete cessation of seizures. The ketogenic diet should be considered as a treatment for dogs with seizures.

75.

LONG-TERM KETOGENIC DIET IMPACTS MOTOR BEHAVIOR AND BRAIN PURINE AND DOPAMINE SYSTEMS IN A NEW GENETIC RODENT MODEL OF PARKINSON'S DISEASE

Jacob Rubin '15, Michelle Dyer '17
Faculty Sponsor: William H. Church

A growing body of research suggests that dopaminergic cell death seen in Parkinson's disease is caused by mitochondrial dysfunction. Oxidative stress, with subsequent generation of reactive oxygen species, is the hallmark biochemical product of mitochondrial dysfunction. The ketogenic diet has been found to enhance mitochondrial energy production, protect against reactive oxygen species generated cell death, and increase adenosine, a purine that modulates dopamine activity. The current study evaluates the effects of a long-term (5 month) ketogenic diet on behavioral, neuroanatomical, and neurochemical measures in PINK1-KO rats, a new animal model of Parkinson's disease. Both wild-type and PINK1-KO animals fed a ketogenic diet exhibited significantly higher blood beta-hydroxybutyrate levels. PINK1-KO animals fed a normal diet experienced a decrease in stride length and an increase in stride frequency over time which was absent in PINK1-KO animals fed a ketogenic diet. Animals fed the ketogenic diet had decreased tissue content of both adenosine and inosine in the nucleus accumbens, posterior caudate, hippocampus, and substantia nigra. Preliminary analysis of catecholamine data shows that the ketogenic diet rescued dopamine cell loss in the substantia nigra of PINK1-KO rats as indicated by a decrease in dopamine content of only 8% compared to 46% seen in PINK1-KO animals fed a normal diet. Immunohistochemical analysis of TH-positive cells supports these findings. The results of the present study indicate that long-term ketogenic diet impacts both motor and neurochemical systems in a genetic rodent model of Parkinson's disease.

PINK1-KO (1.37) showed 46% decrease in the substantia nigra compared to wild-type (2.53) (both normal diet)
Wild-type KD (3.13)
KO KD (2.33)

76.

PROSPECTIVE MEMORY AND JUDGMENTS OF LEARNING: MEASURING THE EFFECTS OF TRAUMATIC AND MILD TRAUMATIC BRAIN INJURY

Marissa Lee Stein '17
Faculty Sponsor: Sarah Raskin

This study will look at the effects of traumatic brain injury/mild traumatic brain injury (TBI, mTBI) on prospective memory and judgments of learning. Prospective memory is often referred to as "remembering to remember" and is an integral part of daily life. Judgments of learning refer to an individual's self-assessment of their ability to recall information.

Research that has assessed the effects of TBI/mTBI on judgments of learning, and prospective memory in particular, has been conducted by Kliegel, et al. (2011), Raskin, Buckheit & Waxman (2011), and Knight et al. (2005), as well as others. Previous research has noted that prospective memory failures are the most frequently reported memory deficit post- brain injury (Raskin, Buckheit & Waxman, 2011), and that those who have sustained TBI/mTBI displayed tendency to overestimate their memorization ability (judgment of learning) while control groups underestimated their ability (Knight et al., 2005). This research seeks to support previous findings.

77.

THE EFFECTS OF FORWARD AND REVERSED VISUAL MOTION STIMULI ON BRAIN ACTIVITY

Nadine Taghian '17
Faculty Sponsor: Dan Lloyd

In functional magnetic resonance imaging (fMRI), brain activity is measured based on changes in blood flow. A stimulus causes an increase in blood flow to a brain region, causing a specific area to activate representing activity in the brain. In this research, we analyzed fMRI data from a single subject in a mixed paradigm that involved resting and viewing or listening to short video or audio clips, some played in their normal forward direction and some reversed. The purpose of this study is to compare the visual stimulus that the single subject observed when watching short video clips to the activity on the brain scans. We are looking for the correlation between the visual stimulus and if the brain areas commonly associated with vision show activity, the comparison of forwards and backwards videos, and the comparison of different content in the video. After analyzing 30 components of brain scans, we found 9 components that showed a significant amount of activity in the visual systems confirming that the traditional areas are active. After investigating the videos direction forwards versus backwards, we found a significant difference ($p=0.0282$) between activity in the visual brain regions, confirming that watching a video backwards causes more brain activity in the visual system than watching it forwards. The single subject also watched clips of urban and nature settings and found that there is a significant difference ($p=0.0500$) in brain activity while watching specific video contents. These results suggest that the brain needs to work harder in order to visually perceive a backwards moving image. Since a person usually only sees life in a forwards motion, the visual system needs to be more active to order to interpret a backwards motion.

78.

SKIN CONDUCTANCE RESPONSES AND NEUROIMAGING CORRELATES OF FEAR CONDITIONING AND FEAR RENEWAL IN HEALTHY CONTROLS AND TRAUMATIZED INDIVIDUALS WITH AND WITHOUT PTSD

Javier C. Weddington '17
Faculty Sponsors: Marie-France Marin Ph. D., Rachel G. Zsido, Huijin Song, Natasha B. Lasko Ph.D., Mohammed R. Milad Ph.D., Psychiatric Neuroimaging Division, Massachusetts General Hospital

Post-traumatic stress disorder (PTSD) is the only major mental disorder for which a cause is considered to be known: that is, an event that involves threat to the physical integrity of oneself or others and induces a response of intense fear, helplessness or horror. Although PTSD is still largely regarded as a psychological phenomenon, over the past three decades the growth of the biological PTSD literature has been explosive, and thousands of references now exist. Ultimately, the impact of an environmental event, such as a psychological trauma, must be understood at organic, cellular and molecular levels. This research person into the relationship between PTSD onset across three different cohorts including : healthy controls (HC), trauma exposed-non PTSD (TENP), and those who have developed PTSD. Results suggest a pattern of resilience in TENP that may prevent onset of PTSD symptoms.

79.

THE EFFECTS OF THE KETOGENIC DIET ON INFLAMMATORY PAIN

Livia Wyss '16
Faculty Sponsors: Susan A. Masino, David N. Ruskin

BACKGROUND: Pain is the most common ailment around the world, according to the American Academy of Pain Medicine; 100 million Americans suffer with chronic pain, which is more than any other main disorder and is described by more than 60% as impacted their overall enjoyment of life (AAPA). The ketogenic diet (KD) is a high fat, low carbohydrate dietary regimen, which is described to decrease neuronal excitation, increase ketone bodies and ATP levels, while lowering glucose and proinflammatory cytokines. The KD is an effective therapy for epilepsy; a disorder that arises from either lowered inhibition or increased excitation, similar to pain. The goal of the current study is to establish whether the KD is effective in lowering inflammatory pain in a rat.

METHODS: We investigated whether a strict KD decreases inflammatory pain in adult male rats. Rats were maintained on either the KD or a standard diet for two to four weeks. We obtained both physiological measure and behavioral measures before and after being injected in the right hind paw with heat-killed tuberculosis bacteria (CFA) to cause inflammation. Physiological measures included weight, paw volume, paw weight, blood ketone and blood glucose levels. Tactile sensitivity and spontaneous pain was used to assess behavioral pain.

RESULTS: Blood chemistry in ketones was altered in rats after the KD. Paw weights and volume had a significant difference between the two diet groups after the CFA injection. A significant difference in ketone levels was noted indicating ketosis. Tactile sensitivity did not differ between treatment groups before injection, but was strongly increased at 4 hours post-injection in both treatment groups. However, at 48 hr post-injection, sensitivity was still high in

the control diet group but was no longer different from baseline in the KD group. Spontaneous pain showed no significant difference between the KD and CD groups.

CONCLUSION: The data suggest that KD feeding promotes recovery after inflammatory insult, however spontaneous pain did not illustrate a reduction in nociceptive pain. Paw weights and volumes suggest that the paw is less swollen and healing more. Future research will aim to elucidate whether there is an effect of the KD on inflammatory pain by using lower amounts of CFA, as this dose may have been too great for the KD to cause a convincing significance.

80.

A MUSICAL ANALYSIS OF BRAIN ACTIVITY ON THREE DISTINCT CONDITIONS OF STIMULI

Michael Zarra ‘19
Faculty Sponsor: Dan Lloyd

A comprehensive analysis of fMRI scan data has much much to reveal about brain activity in response to certain stimuli. During an fMRI scan, a subject’s brain function was observed at a rest state, when being exposed to unfamiliar auditory and visual stimulation, and when being exposed to the reading of a poem familiar to the subject; *Fern Hill* by Dylan Thomas. The overall resulting brain activity throughout the experiment, approximately eighteen minutes in length, was captured in images taken every 0.475 seconds. These images were further dissected using independent component analysis, which allowed activity in the brain to be attributed to one of thirty distinct regions. By determining components in the brain that were more active during the familiar stimulus, compared with the rest state and unfamiliar stimuli, regions of the brain were identified as crucial players in reacting to known stimuli. Six distinct components were identified along with the Brodmann areas and the physiological locations on the brain they represented. These results, although not conclusively a product of any one particular element of the familiar stimulus, could reveal much about how the brain responds to recognizable stimulus or the unique syntax of poetry. Furthermore, by assigning different pitches to each of the six significantly active components for each stimuli condition, one could hear how brain activity changes when encountering familiar and unfamiliar stimuli. The implications of this work are both broad and far-reaching. In addition to expanding our knowledge of the brain, musical display of these findings can make the field of neuroscience more readily accessible to the world. By allowing virtually anyone to conceptualize profound differences in brain activity through sound, a far more intuitive cognition than interpreting fMRI scans, knowledge and appreciation for the science are augmented.

PHYSICS

81.

MODIFICATION OF A TRANSMISSION ELECTRON MICROSCOPE TO ACHIEVE FOUR-DIMENSIONAL ULTRAFAST ELECTRON MICROSCOPY (4D-UEM)

Aashwin Basnet ‘19, Parker Brown ‘19
Faculty Sponsor: Brett Barwick

Microscopy has long served as an integral part of scientific research, and its technology has advanced with time – developing, for instance, from simple devices such as the optical

microscope to more complex ones such as scanning and transmission electron microscopes (SEM and TEM, respectively). Further modifications in the functioning of TEM have opened up an exciting field of research dubbed Ultrafast Electron Microscopy (UEM), or 4D electron microscopy. This technique allows for capturing an image in three dimensions of space, along with a fourth dimension of time. UEM is achieved by combining an ultrafast laser with a TEM. A femtosecond (10^{-15} second range pulse duration) laser is used to emit a beam that will be split in two on its path to the TEM. One of the resulting laser beams -- the electron generating pulse -- is directed to the region of the TEM that emits the electron beam for imaging, while the other -- the excitation pulse -- is guided directly to the sample itself. This excitation pulse provides stimuli to the sample, while the electron generating pulse allows for imaging to occur. This technique can achieve a frame rate of approximately 10^{12} frames per second, which allows it to essentially function as a video, and provides the aforementioned temporal resolution. Presently, tangible results of the research are pending. With this technique, however, characterization of materials and responses of samples to intense stimuli can be observed. This has numerous applications in a variety of fields such as the study of ephemeral nucleation of liquid-to-crystal phase transition and carrier interface dynamics in p-n junction semiconductors, as the unique technology permits dynamic observation on the nano-scale and smaller -- both spatially and temporally.

PSYCHOLOGY

82.

TRINITY COLLEGE STUDENTS' PERSPECTIVES ON SEXUAL ASSAULT

Haley Baldwin '16, Lara Guida '17, Abby Hughes '16, Jocelyn Redding '16
Faculty Sponsor: Dina L. Anselmi

Our research attempted to gage college students' views of sexual assault. We wanted to know if gender roles and sexism influence individuals' beliefs about rape. We hypothesized that people who endorse masculine social roles will be significantly more likely to believe myths about rape. We also hypothesized that those who have more sexist views towards women will be less likely to believe rape victims. Lastly, we hypothesized that men and women would have different views about sexual assault, especially when it comes to what constitutes rape and the behaviors of the victim of the rape. We surveyed 200 Trinity College Seniors and 43 participated in the study. We used three measures:Male Role Norms Inventory, (Thompson and Pleck, 1986), the Attitudes towards Women Scale (Spence, Helmrich & Stapp, 1978), and the Illinois Rape Myth Acceptance Scale (Payne & Lonsway, 1999). We found that people who did not subscribe to typical male social norms were also likely to disbelieve rape myths. Similarly those who scored lower on sexism did not endorse rape myths. We also found that while on average, both males and females did not believe in rape myths, females typically disagreed more against the rape myth than males.

83.

DIFFERENCES IN DRINKING HABITS OF TRINITY COLLEGE STUDENTS

Alexandra Bazar ‘16, Paige Durovsik ‘16, Catherine Krug ‘16, Susannah Matthai ‘16
Faculty Sponsor: Dina L. Anselmi

The prevalence of alcohol misuse among college students has been an increasing issue across college campuses in the United States. In response to this issue, there has been an ongoing effort to determine the factors that lead students to binge drink. The purpose of this study was to investigate the factors that affect drinking behavior in relation to peer influence and parents’ disciplinary methods. A random sample of 200 seniors and 200 first-year students were surveyed; 117 students completed the survey (56 first-year students and 61 seniors). We hypothesized that (a) first-years’ drinking habits would be more influenced by peer drinking habits resulting in a stronger positive correlation for first-years than for seniors; (b) alcohol consumption (i.e., number of days per week) for both first-years and seniors would be similar but first-years would binge drink more; (c) students who perceived their parents to be authoritarian would be more likely to engage in binge drinking compared to students who perceived their parents as permissive or authoritative. The only significant result we found was that first-years and seniors drank a similar amount of times throughout the week. This suggests that first-years do not engage in more binge drinking and are not more influenced by peers compared to seniors.

84.

FACTORS THAT PROMOTE ENGAGEMENT IN A YOUTH VIOLENCE PREVENTION PROGRAM

Lyndsay Brattan ‘16
Faculty Sponsor: Laura Holt, Compass Peacebuilders

Youth in Hartford, CT are exposed to violence in their community at a disproportionately higher rate than youth residing in suburban and rural communities throughout the state. Within Connecticut, Hartford has a rating of five on the crime scale (100 meaning the safest) compared to West Hartford, which is rated as 32, and Wethersfield, rated 54. Numerous school- and community-based programs have been established to confront this epidemic; however, less is known about the specific components of these programs that maximize youth attendance and engagement. Youth violence prevention programs are most successful when participants feel comfortable sharing their experiences and vocalizing their emotions, so it is important to understand the dynamics of the program that might help youth to feel more or less comfortable participating in the program. My study sought to understand the factors that affect youth participation in a Hartford-based youth violence prevention program. Specifically, I conducted a focus group with seven Peacebuilder facilitators in Hartford, Connecticut, in the spring of 2016 in order to understand their perspectives about which topics were most engaging to youth and which modes of delivering the intervention seemed to be most effective. My findings suggest that factors such as mentor credibility and flexibility in implementing the curriculum are among the key factors that contribute to the success of engaging youth in this program.

85.

THE EFFECT OF PARTICIPANT ENGAGEMENT ON COCHLEAR IMPLANT SPEECH PERCEPTION

Hunter Drews ‘16
Faculty Sponsor: Elizabeth Casserly

Cochlear implants are devices that are used to restore hearing for individuals with significant hearing loss. These devices often require a certain level of training to be beneficial and research has shown that current training methods relatively ineffective in helping patients understand real-world sounds. This study aimed to improve the current standard training by manipulating engagement with auditory training information. An oral response mode and the use of talk-show interview scripts in an audio-visual condition were investigated as alternatives to standard lab training based on their perceived ability to increase participant engagement during training. Normal-hearing participants (N = 60) were assigned to one of four training conditions: non-vocoded speech control training, standard vocoded-speech laboratory training, oral-response training, and audio-visual training. In all cases, participants completed two pre-training assessments, one hour of training, and five post-training assessments to gauge the amount of learning that occurred across time and training conditions. Results indicated that the standard, oral-response, and audio-visual training groups had significant learning gains in the sentences in quiet (SQ) test; the oral-response and audio-visual training groups demonstrated similar effects in the sentences in babble (SB) test. We concluded that the significant learning gains that were achieved when pre- and post-training assessments were compared across groups are indicative of real-world benefits of these novel training methods. Engagement responses of participants also indicated that how well the participant performed on assessments was correlated with their level of engagement.

86.

LEARN 2 LEARN: A METACOGNITIVE INTERVENTION FOR 6th AND 8th GRADE STUDENTS

Bettina Gonzalez ‘16, Lauren Thomann ‘16
Faculty Sponsors: Dina L. Anselmi, David A. Reuman, Debra Avery, Timothy Roarty, HMTCA

Our research explored the effect of metacognition training on the academic performance of middle-school students. Intervention sessions for 6th and 8th graders were designed and implemented to enrich metacognitive skills, developed based on Ambrose et al.’s (2010) model of metacognition. Two classrooms of 6th and 8th graders received the *Learn 2 Learn* metacognition curriculum, while two other classrooms in both grade levels received the control curriculum on school transitions for either high school or college. Students’ level of metacognition and motivation were measured with pre- and post- qualitative and quantitative assessments. Quarterly grades were assessed from report cards. Overall, the pattern of the MC5 interaction for time by condition was what we expected, although it only approached statistical significance (p = .11). The 6th graders showed higher levels of metacognition, self-efficacy, and engagement than the 8th graders, and lower levels of anxiety. As expected, metacognition and motivation are positively correlated with academic performance.

87.

ENRICHING STUDENT SUCCESS THROUGH METACOGNITIVE SCHOOL-BASED INTERVENTION: FOLLOWING STUDENTS FROM MIDDLE SCHOOL INTO HIGH SCHOOL

Elizabeth Caporale '16
Faculty Sponsor: Dina L. Anselmi

Current research suggests strong links among metacognition, motivation, and academic success. Our research consists of two related studies regarding the development of metacognition and motivation in middle and high school students and is a follow-up to intervention studies with 8th grade students, conducted in 2013-14 and 2014-15 at Hartford Magnet Trinity College Academy. Study 1 compared current 9th and 10th grade students' metacognition and motivation. Contrary to prediction, results from Study 1 indicated a higher level of metacognition for 9th grade students than for 10th grade students. Academic self-efficacy, a component of motivation, was also higher for 9th graders than for 10th graders. Study 2 compared students' metacognition and motivation when they were in 8th grade with levels now, as the same students are in either 9th or 10th grade. Study 2 results indicated no long-term intervention effect for students in either grade level; additionally, 9th grade students, again, showed a higher level of metacognition than 10th grade students.

88.

TEACHERS' KNOWLEDGE AND USE OF STRATEGIES TO TEACH METACOGNITION

Kata Sik '16
Faculty Sponsors: Dina L. Anselmi, David A. Reuman

I conducted this investigation as an extension of an ongoing project to teach metacognition to middle school students in Hartford, Connecticut. The ongoing project has had difficulty elevating students' metacognition through the intervention. One possible explanation for this difficulty is that participating classroom teachers are already engaged in teaching metacognition to their students, so that the researchers' intervention cannot improve on what teachers are already doing. I examined the relationship between the participating teachers' knowledge and classroom use of metacognitive strategies, both through a self-report questionnaire and through observational coding of video-recordings of teachers. The Teachers' Metacognition Scale (Wilson & Bai, 2010) assesses teachers' knowledge in different domains of metacognition (procedural, declarative, conditional, pedagogical). The observational coding system (Spruce & Bol, 2015) distinguishes between teachers' metacognitive references versus directed metacognitive activities in the classroom. Comparing the two participating teachers' scores on both questionnaire and observational measures against averages from teachers in prior research shows that the participating teachers not only score above average on various metacognitive measures, but also differ from each other. This investigation has led to a better understanding of how the teachers' use of metacognition has made it difficult for the intervention to show effects.

89.

HOOK UPS AND RELATIONSHIPS: DIFFERENCES IN MOTIVES AND THE EFFECT OF RACE OR ETHNICITY

Chloe Jackson-Unger ‘16, Kata Sik ‘16, Gio Quattrochi ‘16, Jamie Ballan ‘16
Faculty Sponsors: Dina L. Anselmi, David A. Reuman

This study was designed to determine whether there were differences among various racial and ethnic groups in regard to motivations for hooking up verses having a relationship. We sent our survey to 400 randomly selected Trinity Students and 176 students responded. The survey contained questions about motivations to hook up as well as to get into a relationship. It also included questions concerning people’s attitudes about hooking up and having a relationship with those of the same and of a different race or ethnicity. We found that men’s scores on social sexual motives for hooking up were significantly higher than for women’s scores. We also found that participants were more open and likely to hook up and have a relationship with a person within their own racial or ethnic group than outside their racial or ethnic group. The most common reason behind participants’ likeliness to engage in sexual and romantic involvement with another person of any race or ethnicity was attraction, and the least common reason was parental influence. However, preferences towards interracial relations varied significantly by race. Asians scored lower on openness and likeliness to hooking up and getting into relationships than any other racial group.

90.

AN EXPLORATION OF SUBCULTURES AT TRINITY COLLEGE

Ellen Gustavson ‘16, Owen Brubaker ‘16, AJ Ballard ‘16, Eszter Csuvarszki
Faculty Sponsor: Dina L. Anselmi

The purpose of this experiment was to identify and analyze student subcultures at Trinity College. The issues central to this analysis regard how inclusive or exclusive these subcultures are and whether or not tension arises between them on Trinity’s campus. We gathered information by interviewing Trinity students and transcribing the interviews that were then coded to answer various themes. We found that Trinity students tend to identify the subcultures of Greek life and athletics most often. Additionally, a large portion of students perceive tension between subcultures. Our findings may suggest that the overall student culture and social scene places most emphasis on Greek life and athletics, and also speaks to a larger problem of how, moving forward, the college can ease tension between various subcultures.

91.

PREVENTING AND REDUCING NON-MEDICAL STIMULANT USE: AN INTERVENTION STUDY

Tyler R. Hightower ‘16
Faculty Sponsor: Laura Holt

Numerous studies have shown that nonmedical prescription stimulant use (NMPSU), which refers to the use of drugs like Adderall or Ritalin without a prescription, is quickly becoming one of the most prevalent illicit activities on college campuses. In a recent study on Trinity’s campus,

37% of students endorsed misusing prescription stimulants in the last year. Not all students are at equal risk, however. Risk factors for NMPSU include: being Caucasian, Greek involvement, low GPA (less than 3.5), binge drinking, marijuana use, and low self-efficacy to avoid using. Accordingly, we screened students for these risk factors and engaged students with two or more risk factors, or those who reported a history of NMPSU. Because only one intervention has been reported on in the literature, we utilized motivational interviewing (MI), a strategy that has been used to reduce heavy drinking in college students, in an attempt to reduce NMPSU and to potentially change NMPSU-related attitudes. MI works by "lowering patience resistance, allowing patients to arrive at their own decisions about the severity of their problem and a possible need for change" (Foote et al. 1999). Seventy participants screened in and 56 (80%) of the participants completed the 1-month follow-up survey. The intervention did not have an effect on study self-efficacy, or expectations for cognitive enhancement, feelings of guilt and dependence related to NMPSU, social enhancement expectancies, and concerns about anxiety and arousal from NMPSU. There was a trend towards intervention group participants being more knowledgeable about the side effects of stimulants when misused. Implications for future research are discussed.

92.
INCORPORATING SIMULTANEOUS MULTIPLE TALKERS AND SEMANTIC COHESION INTO AUDITORY TRAINING
Thea Krizmanich '16
Faculty Sponsor: Elizabeth Casserly

Auditory training (AT) is used to improve speech comprehension in cochlear implant (CI) users. While the current training method is an effective tool for understanding speech in ideal listening conditions, the learning gains do not generalize to many real-world interactions. Previous research on CIs has established that the incorporation of top-down information (contextual cues) improves comprehension, as does multiple talker training. We hypothesized that a training program that combines these two disparate training tools would produce generalizable learning (measured via performance in post-tests). To test this hypothesis, we created two training programs (audio-only and audio-visual) that incorporated continuous, meaningful speech from fifteen television interviews. By comparing post-test performance in the experimental conditions to the standard training method, we found that we were able to successfully combine the two independent effects into a single hour-long session, with participants improving their perceptual skills across a number of domains.

93.
PERCEIVED PARENTAL INFLUENCE ON AN ATHLETE'S CAREER
Daniel Larkins '16, Elizabeth McQuaid '16, Kayla O'Connor '18, Matthew Porter '16
Faculty Sponsor: Dina L. Anselmi

Our project looked at how both negative and positive parental involvement influences athletes' anxiety, enjoyment, and motivation. We also looked at if there were differences in anxiety, enjoyment and motivation between male and female athletes. We hypothesized that female athletes would have significantly higher levels of anxiety, lower levels of motivation, and lower levels of overall enjoyment than males. We distributed an online survey to the Trinity College Football Team, Men's and Women's Tennis Teams, Women's Softball Team and Women's Ice

Hockey Team.The survey contained questions from the Parental Involvement in Sports Questionnaire, The Sport Motivation Scale, The Sport Anxiety Scale, and The Physical Activity Enjoyment Scale that looked at perceived parental involvement, motivation, anxiety, and overall enjoyment (Lee & MacLean,1999; Pelletier, Fortier, Vallerand, Briere, Tuson, & Blais, 1995; Smith, Smoll, Cumming, & Grossbard, 2006; Kenndrierski & DeCarll, 1991). Results from 73 student-athlete's indicated that perceived parental influence, positive or negative, does not appear to be associated with an athlete's level of anxiety. However, positive parental influence was correlated with athletes' intrinsic motivation and negative motivation. Also, negative parental involvement appears to impact athletes' enjoyment, motivation and anxiety to a lesser degree.

94.

PARENT REPORT ON THE IMPACT A SERVICE DOG HAS ON CHILDREN WITH AUTISM SPECTRUM DISORDER

Danielle Rock '16
Faculty Sponsor: Molly Helt

Previous research has shown pet ownership to be associated with increased social skills and prosocial behaviors for children with Autism Spectrum Disorder (ASD) (Carlisle, 2014; Grandgeorge, Tordjman, Lazartigues, Lemonnier, Deleau, & Hausberger, 2012). The present study evaluates whether a child with ASD can bond with, or create a significant attachment to, a service dog, and, if so, whether parents will report that this bond has strengthened the child's social skills and been accompanied by an overall improved quality of life for child and family. Parents (n = 7) of children with ASD completed an online survey, quantifying the severity of their child's autism symptoms at baseline (i.e. before acquiring the dog), measuring the child's bond with their service dog, and exploring, via a set of qualitative questions, whether parents observed any change in their child's social behaviors and overall quality of life after receiving the animal and having it for at least one year. Findings indicate that n = 6/7 of the children were capable of developing a significant bond with their service dog. In addition, all of the parents reported an increase in at least some of the child's social behaviors and that the quality of family life had improved. Furthermore, there was a positive correlation between attachment and perceived change ($r = .23$, $N = 7$, $p = .62$), whereby, as attachment increased so did the parental perception of positive change in social skills and quality of life. It is our hope to elucidate the benefits of utilizing service animals as a therapeutic tool for the enhancement of social functioning and quality of life in children with ASD.